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LECTURES IN PEDIATRICS

NORTH CAROLINA POST-GRADUATE COURSE
1916

LEWIS WEBB HILL, M.D.

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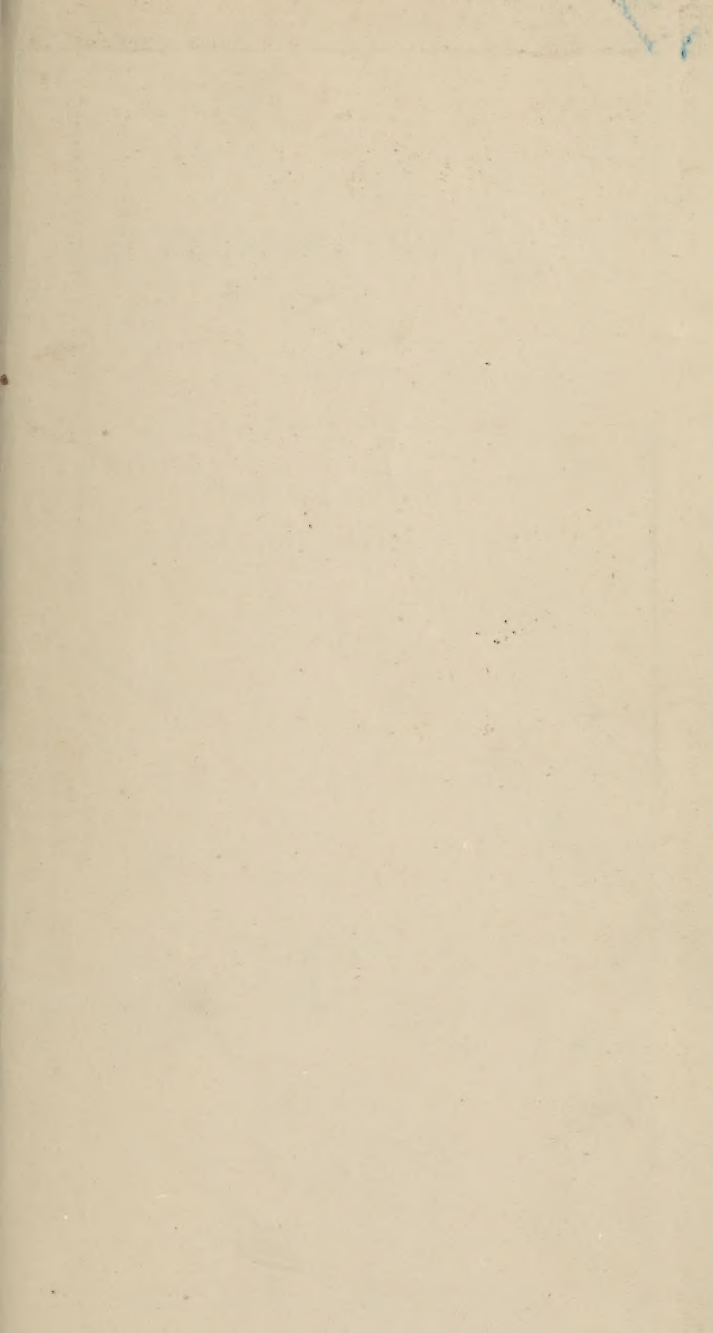
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LECTURES IN PEDIATRICS

TO THE

NORTH CAROLINA
POST-GRADUATE COURSE

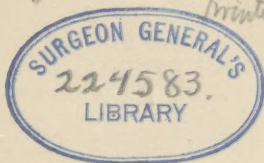
1916

BY

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LECTURE I

INTRODUCTION TO FEEDING IN GENERAL BREAST FEEDING

JUNE 5, 1916.

Pediatrics, or diseases of children, is naturally divided into a number of sections, of which the most important is the feeding of infants and the treatment of the diarrheal diseases of infancy.

My lecture today is somewhat of an introductory lecture, taking up breast feeding and a short introduction to artificial feeding. We have to go a great deal into theory, but I am going to ask you to take an interest in it, because it is absolutely necessary and fundamental as a basis on which to work.

In the first place, I am going to teach you the so-called percentage method, which is used in Boston, more than in any other city. In the old days of infant feeding there was no science at all of any sort. A little milk and water was mixed and fed to the baby, without knowing what he was getting of food-value; of fat, sugar, etc. Some babies got along very well on this. But, as you know, some will get along on almost anything; some need the utmost care.

Dr. T. Morgan Rotch, about twenty-five years ago, devised the so-called percentage method. This means that when you are feeding a baby you have to recognize certain *elements* in the milk. Milk consists of fat, sugar, and protein, and you have to know *how much* of each the infant is getting, because digestive disturbances of all sorts are likely to be due to too much or too little of one element or the other in the milk. This method simplifies the whole matter of feeding, because you know with what you are dealing. There is no reason why the baby should not have his milk made up in just as accurate a way as a prescription is made up. With adults it is not necessary to regulate the food so carefully, because an adult's digestion is stronger, and small things will not upset him so easily. The percentage method of feeding consists simply in writing a pre-

scription for the baby's milk, knowing approximately how much of each food element you are giving him.

As an introduction, I think I cannot do better than to read a few lines written a short time ago by Dr. Ladd, of Boston:

"Now, whatever our method of making a food for infants, in which milk is the basis, we are making a *modified milk*, containing certain percentages of the elements. Percentage feeding presupposes that these alterations have been made by the physician with design and with a definite knowledge of the end result of his changes. By the old method, milk was modified, quite as much as by modern methods, but with this fundamental difference: that the physician had not the slightest conception of the composition of his mixture, and hence no check upon his results. Without a knowledge of the percentage composition of the milk, it is next to impossible to give a lucid and intelligent expression of its food value. A mixture expressed as so many ounces of cream, milk, lime water, sugar, and water, may exactly fulfill the requirements of an individual infant, but, unless I can express such a formula to a student in percentages or calories, or both, my exposition of the principles on which I have acted in prescribing such a formula is vague and indefinite.

"Whatever we may feel about the relative values of fats and sugars and proteins, and the proportions best suited to individual conditions, the percentage method of thinking, writing, and prescribing should not and does not complicate the question. In fact, it simplifies it enormously, for it furnishes us the means for accurate estimation of food values—and only by such knowledge can we intelligently check up our results when struggling with the problem of adapting a food to the individual requirements of an infant.

"If one will grasp this simple idea of percentage feeding, one will disabuse one's mind of the conception, so erroneously held, that percentage feeding is ultra-scientific, very mathematical, complex and impractical for the average practitioner.

"I wish to emphasize the fact that the purpose of percentage feeding is, on the contrary, to simplify the sometimes very difficult question of finding a food which the infant will digest and upon which it will gain normally in development. The mathematics involved in the calculation of percentages are of the simplest—a mere matter of proportions. If properly presented, any one of half a dozen in vogue is easily mastered and perfectly practical. It does not matter by whose methods one works to gain this fundamental knowledge of how to calculate the percentage elements of the food, so long as that method is thoroughly mastered. Some methods are simpler to understand than others, and any method requires some study and practice, but this hardly offers an excuse for ignorance of the subject. Any third-year medical student may in two hours be

taught a practical way of calculating percentages and estimating the caloric value of any mixture. Such knowledge is rudimentary but fundamental. Any physician who pretends to feed scientifically should not shun the task of acquiring this knowledge, any more than he should avoid the labor involved in grasping the technique of simple surgical or bacteriological procedures, in order to become more skilled in the practice of modern medicine. Too much is written of the difficulties of these methods of calculation by men who have been too lazy or indifferent to learn them; too little has been written about the responsibility of the physician to master them in order to become a more efficient worker along the lines of modern infant feeding."

That is a very good summing up of the question of percentage feeding. *In a nutshell, you have to know, in any milk mixture you are giving a baby, how much fat, how much protein, and how much sugar it contains.* In order to do this we have to know the composition of milk, and I am now going to compare the composition of cow and human milk.

Human milk contains 4 per cent of fat, 7 per cent of sugar, 1.60 per cent of protein, and about .2 per cent of salts. Cow's milk contains 4 per cent of fat, 4.5 per cent sugar, 3.2 per cent protein, and .7 per cent salts. Now, different human milks vary a great deal. Different cows' milks vary a great deal, but these are the average figures.

Besides the quantitative differences, there are also certain qualitative differences. The fat in the milk is in the form of an emulsion; the sugar, protein, and salts are in solution. The globules of fat in cow's milk are much larger than in human milk. The sugars are exactly the same.

In all milk there are two kinds of proteids—casein, and albumin or whey proteid. In woman's milk there is more whey proteid than casein. The ratio is about three to one. In cow's milk there is more casein than whey, and this is one reason why cow's milk is harder to digest, because the casein proteid is coagulated in the stomach into tough curds. The whey proteid is not. The salts are qualitatively about the same in both milks, the most important being salts of sodium, potassium, magnesium, calcium, iron, phosphorous, and sulphur. The salts are of extreme importance in the nutrition of any baby, but we cannot take them into practical consideration in feeding a baby. So we are going to con-

sider the three elements, fat, sugar, and protein. It is very important to bear in mind this composition of milk.

Now, I want to run over very briefly the digestion of the different food elements. First, the fat—it is not acted upon to any great extent in the stomach. Chemically, it consists of a fatty acid in combination with glycerine, forming a so-called “neutral” fat. After leaving the stomach, it enters the intestine, where it is split down by the pancreatic juice into glycerine and a fatty acid. The fatty acid combines with an alkali in the intestine, forming a “soap.” This is acted upon by the bile, which emulsifies it, and it is then absorbed. The absorption of fat is usually very good. Often ninety or ninety-five per cent of the fat taken in will be absorbed by a well baby. In other cases as little as thirty to forty per cent will be absorbed, and most of the fat will come out in the stool in the form of “soaps.”

The sugar is acted upon very little in the stomach. Milk sugar is what is known as a di-saccharide, that is, a complex sugar. In the intestine it is split into simpler sugars and absorbed as such. The absorption of sugar is usually extremely good. It is very rare to find any in the stools of infants. Sugar may sometimes remain in the intestine, and may be broken up by the bacteria in the intestine into acids; as acetic acid and butyric acid. Fats may also be broken up in this way.

Now we come to protein. Protein is partly digested in the stomach, where it is coagulated by the gastric juice. Digestion is carried on further in the intestine by the pancreatic juice, and the products are absorbed as salts of the amino acids. Now, we always have in the intestine of any child two forces working against each other. That is, all the end products from the breaking down of fat and sugar are acid in reaction; those from the breaking down of protein are alkaline in reaction, from the ammonia which is formed. The normal reaction of a child's stool is slightly alkaline, slightly acid, or neutral, and if there is too great acidity or too great alkalinity, trouble results. It is very important to have such a balance between the fat and sugar and the protein in the food as not to have too great acidity or too great alkalinity in the intestine.

You have heard a lot of talk about calories. What is a calorie? Of course, all food is fuel. The human

body resembles a steam engine. The different elements of food have different fuel values, and we measure these by calories. A calorie is the amount of heat that is necessary to raise one liter of water one degree centigrade. That is a "large" calorie, which is the one we use in infant feeding. The average baby needs about fifty calories per pound of body weight in order to flourish.

The different food elements produce different amounts of these calories. Fat produces 9.3 calories per gramme; protein and sugar each produce 4.1 calories per gramme.

That covers most of the theoretical part of feeding, and although it does sound rather complicated and not very practical, it is essential to bear all these things in mind, because, if you are going to feed scientifically, you have to have a basis to work on. You have to remember and take interest in and know all these theoretical data before you can feed a baby scientifically, and understand the principles involved.

BREAST FEEDING

In regard to breast feeding, *it is an axiom that every baby should be fed on the breast, if possible.* I don't think as many women nowadays are feeding their babies on the breast as formerly. There are several reasons for this, one of which is that women lead a more sedentary life than they used to. Still, a great many women can feed their babies on the breast, and it should be insisted upon in every case that a mother should nurse her baby through the first year, if possible. Of course, in some cases a baby must be weaned, but these are comparatively few and far between. *Persist in it.* If a mother has not enough milk, try to find out why. Look after her habits, see that she leads a proper life, etc.

Another thing: sometimes the milk is late in coming into the breast. Normally, after a baby is born the milk comes into the breast in from twenty-four to forty-eight hours. Sometimes it is delayed for four or five days. However, don't take the baby off the breast because the milk is late in coming.

What are you going to do with a new-born baby? During the first six hours give him a tablespoonful or two of boiled water. At the end of that time put him to the breast. This may not do much good, but it teaches

him to suck and it stimulates the breast to produce milk. For the first twenty-four hours he should be nursed every six hours; for the next day every four hours; for the first few weeks after that every two hours.

There is a great deal of discussion in all the pediatric centers about the intervals between nursings, but I really think most of the intervals, that is, two, two and one-half, three, or four-hour intervals are all right. Most normal babies get along well on any of those intervals. Personally, I think it is best to have the baby nursed every two hours during the first month; for the next three months every two and one-half hours; after this every three hours. It is a good thing to have the baby take one bottle a day. It gives the mother more time to get out and take exercise than if the baby had to be nursed every time.

In the new-born baby, if the bowels have not moved well soon after birth, it is wise to give a small dose of castor oil, because the meconium may undergo decomposition and make the baby ill from toxic absorption, so it is important to clean him out artificially if he has not cleaned himself out naturally.

It is important to have the baby nursed regularly, and not every time he cries. Have this distinctly understood by the mother. If the baby is asleep at the time he should be waked.

It is better to feed the baby alternate breasts rather than a little out of one and a little out of the other. If one is used for each nursing, the baby will empty it and thus stimulate it to the production of milk.

An average baby will empty the average breast in about fifteen minutes. Of course, this time may vary, but that is usually the average.

A baby does not take the same amount of milk from a breast at each nursing. At some feedings a baby will take only one or two ounces; at others he will take six or seven. But this is not very important, because most babies get the same amount every twenty-four hours. If he takes little at one feeding, he will make it up at another. The twenty-four hour amount is the important thing to consider.

Sometimes it is important to know if a baby is getting enough milk in a day, and the best way to learn this is to weigh him before and after each nursing. Take the

difference between the weights before and after nursing, add them all together, and you will learn how much milk the child is getting in a day, as an ounce of milk weighs about an ounce.

It is true that every baby should be fed on the breast, but it is also true that there is abnormal breast milk; bad breast milk. There are three kinds of bad breast milk. The first kind is too rich, it has too much of every element. This type of milk is found in women who eat too much rich food and who do not take enough exercise. The second type is a type in which the fat and sugar are very low and the protein very high. You see this type of milk in the poorer classes of women, who do not get enough to eat and who have to work too hard. The third type of milk is that in which, by repeated chemical analyses, you find that every one of the elements is in perfect proportion, but which, for some reason or other, the baby cannot take. I do not know the cause, but it is unquestionably true that in some nursing women a toxic substance is secreted in the milk and this upsets the baby. In one case I analyzed the milk three times and found it perfectly normal, but the baby could not take it at all, and had to be weaned. These milks are not common, but you certainly will see them sometimes. You ought not to assume, however, that the milk is of this type until you have given the nursing mother a very thorough trial and until you have had the milk analyzed, if possible. Don't give nursing up until you have tried every means of modifying the mother's milk and making it better.

How are you going to modify a mother's milk, that is, modify the chemical composition of it? When a woman has too rich milk the important thing is to take her outdoors—make her exercise, keep her bowels open, don't let her eat too much rich, highly seasoned food, make her drink plenty of water. In the other type, where the milk is too thin, ease up the woman's home life, have her arrange to get some one to do part of her work, have her eat more, especially starchy and fatty food. If the *quantity* of milk, on the other hand, is too small, have the mother drink plenty of fluid. I have many of my nursing mothers take cornmeal gruel at night before going to bed. Another thing, *use* the breast. If the baby is weak and small and does not empty the breast,

pump it out. There is no *drug* with which I am familiar that will increase milk secretion.

As to the diet of the mother, I think the best thing to tell a nursing mother in average circumstances is to eat exactly what she would if she had no baby at all, provided she is taking a reasonable diet. Undoubtedly there are certain things that will upset some babies, like cabbage, strawberries, etc. Babies generally get on well, however, if the mother is healthy and eats an average ordinary diet.

How much should a normal breast-fed baby gain? You should weigh the baby every week, so that you can see how much it is gaining and correct the food, if necessary. The normal breast-fed baby should gain six to eight ounces a week for the first five months of its life. For the rest of the first year he should gain four to six ounces a week. If he is not gaining as much as this, there is something wrong.

The breast-fed baby will usually have three or four rather loose, golden-yellow, sour-smelling movements a day. Those on cow's milk usually do not have so many. Certain babies may have more than others. The stool may be green in color and may smell badly. The baby may vomit a little. But if he is getting on well in every other way, it is best not to pay too much attention to this.

Let us take up the abnormal breast-fed baby, the baby who is not gaining on the breast, who has a good deal of colic, who does not sleep at night, who vomits often, who has bad movements; and the thin, poorly nourished breast-fed baby who does not get enough to eat. This may be due to a number of causes. If a baby does not gain, the milk may not be rich enough or there may not be enough of it. In cases like this, substitute feedings should be given, after you have tried to increase the amount and richness of the milk and have failed. Give cow's milk after each breast feeding, or substitute it alternately with the breast. It is a little better to give it after each breast feeding, because cow's milk is better taken care of in the stomach when it is mixed with human milk.

When a baby has colic, when he is fussy all the time, and does not gain, the milk is probably too rich. It may contain too much fat or protein. The sugar in human

milk gives very little trouble. The symptoms of fat indigestion are vomiting of creamy, thick, sour-smelling material, diarrhea, failure to gain, and fussiness. The symptoms of protein indigestion are the same, except that the vomitus is not quite so thick and creamy.

Treat these conditions by treating the mother, in the first place, by taking the mother outdoors, getting her to walk, to take exercise, and by getting her to drink plenty of water. In the second place, keep the baby quiet after each nursing. Do not let the mother jiggle it around, as so many do. Also, it is a very good idea to give a tablespoonful of lime water before each nursing, or two or three tablespoonfuls of boiled water to dilute the milk. Again, it is a good idea not to let the baby nurse too long. He may be getting too much milk. Sometimes if you will increase the intervals between nursings it will help these cases.

As to colic, the treatment is to prevent it, if you can, by regulating the feeding. The best thing to do during the attacks is to give a suds enema, hot applications to the abdomen, half a soda-mint tablet, a few drops of gin or aromatic spirits of ammonia, etc.

A good many healthy babies may have a temporary upset for two or three days which may be due to mental disturbance in the mother. Often some trouble or anxiety of the mother will upset the baby a good deal for a short time.

There are certain indications for weaning. Some people say that if a mother starts to menstruate the baby should be weaned. This is not so. Sometimes menstruation will upset the baby temporarily, but it will probably be all right again in a few days. If a woman becomes pregnant, however, the baby should be weaned immediately in most cases.

If a mother cannot nurse her baby, it is often a very great advantage to get a wet nurse. What are the qualifications of a wet nurse? In the first place, how is the wet nurse's own baby? If it is doing well, the chances are that the other baby will do well. No one should be taken whose own baby is over eight or nine months old, because after this period the milk becomes thin and poor in quality. Every nurse should have a thorough physical examination to exclude tuberculosis and syphilis. A Wasserman should be done on the blood of every wet nurse, if possible.

ARTIFICIAL FEEDING

Now, as to artificial feeding, what kind of milk are you going to use in feeding a baby on a bottle? There is another axiom in pediatrics, *and that is that no milk is too good for a baby.* Get the very best milk you possibly can. Get it from a good dairy, from a farmer who takes care of his barns and his cattle and who is interested in producing good milk. There is nothing else that causes so many babies to die as nasty, unclean milk. Milk is really one of the dirtiest things in the world, because of the conditions under which it is produced, and the ease with which bacteria grow in it. You can take a handful of dirt and throw it into a glass of milk, and then you cannot see it. You can take what looks to be clean milk, put it into a centrifuge, and you will find lots of dirt. An Ayreshire, Holstein, or just plain, ordinary cow is usually a good cow to feed a baby on. A great many people prefer a Jersey, but Jersey milk is too rich. The fat will often run up to six or eight per cent, and the baby may get into a great deal of trouble on account of this high fat percentage.

You can feed a baby on raw milk or on pasteurized or sterilized milk. I have no hesitation in saying that every milk fed to a baby should be pasteurized or sterilized, especially in a warm climate like this, unless it is what is called certified milk. Certified milk composes less than one per cent of the milk supply of great cities. It is produced under the greatest precautions. The cow is washed off, the workers wear white gloves, the barns are sanitary, etc. But, of course, such milk is only a very small proportion of the milk supply, and the milk that babies get should in practically all cases be sterilized or pasteurized. *Insist upon this.* I do not know much about the milk supply of North Carolina, but I think it would be a great deal better if it were pasteurized or sterilized before being fed to babies, and I hope that you will all feed all your babies on pasteurized or sterilized milk this summer.

There has been a great deal of objection to pasteurized milk because some people think it is harder to digest. This is not so. Some people say that it tends to constipate the baby. But what if it does? A slight amount of constipation is better than dysentery. Some people say, too, that it is too much work to pasteurize milk, but

it is really not very much more trouble. The greatest objection is that pasteurized and, more especially, sterilized milk may produce scurvy; but this is not much of an objection. You can cure scurvy in a few days by the use of orange juice, and you can prevent it by the use of two tablespoonfuls of orange juice a day. In Boston all milk fed to babies is pasteurized, except the certified milk. The latter costs twenty cents a quart, and is therefore out of the question for most people. Pasteurization is not an excuse for bad milk. Milk, whether pasteurized or not, should be good milk to start with, if possible.

What is the difference between pasteurization and sterilization? They are two different processes. Pasteurization consists of heating milk to 145 degrees Fahrenheit and keeping it at that temperature for thirty minutes. This does not kill the ferments in the milk, but it does kill almost all the bacteria except the spore-bearing bacteria, of which the gas bacillus is the most important. Sterilizing milk, on the other hand, consists in boiling it, which kills all the bacteria.

A great many devices for pasteurizing milk have been put on the market, but you can take an ordinary tin bucket, put the milk bottles in it, put water in it, and heat it to 145 degrees, and this will answer the purpose. You have to have a thermometer, of course. Then take the bucket off the stove, put some towels over it, and let it stand for a half hour. Then pour off the hot water and fill the bucket with as cold water as you can get. The milk should be cooled as rapidly as possible, because spores develop very soon in lukewarm milk.

Sterilization consists in boiling the milk for four or five minutes. It depends largely upon the kind of people you are dealing with as to whether you should advise pasteurization or sterilization, whether or not they will take the trouble to pasteurize it.

If you are going to feed any baby on pasteurized or sterilized milk, give him some orange juice. The best way to do this is to give it in two doses, a tablespoonful morning and night, and this will prevent scurvy. It is best given about an hour before feeding.

We have talked a lot about modifying milk and about the percentage method. Just how are you going to modify milk? The modification of milk consists in add-

ing water or other substances to cow's milk to change it to suit the digestion of the individual baby with which you are dealing. What is of the utmost importance to remember is *to fit the milk to the individual baby*. There are no definite rules or laws that can be laid down, because babies vary so much in what they will take and in their digestive capacity. The thing to do is to take one method and learn that well. I am going to teach you two slightly different methods, one of modifying the milk by the use of top cream and skim milk; the other by the use of whole milk and water mixtures. Milk sugar, of course, is added in both these methods.

Top or "gravity" cream is all the cream that is visible in a quart of milk in an ordinary milk bottle after the milk has stood for about six hours. It is usually about six ounces of cream, and the composition is about 16 per cent fat, 4.5 per cent sugar, 3.2 per cent protein. There are various methods of taking off this cream, which we will discuss later. What is left behind, after taking it off, is skim milk, which consists of no fat, 4.5 per cent sugar, 3.2 per cent protein. These figures are not exact, but they are what we use in calculating our milks. The skim milk, cream, water, and sugar are mixed up so as to secure the desired percentage of food elements that you want to feed the baby.

The other method of modifying milk consists in diluting whole milk with water and adding milk sugar to secure the desired percentage. This method of whole-milk dilution has one disadvantage, which is that, if you dilute the milk with water, you will reduce the fat percentage too much. You want to reduce the protein, because the protein content of cow's milk is too high for most babies, but you reduce the fat percentage a great deal and you cannot make this up in any way. However, a great many babies do very well on this method, but others do not. Most well babies will do perfectly well on whole milk and water dilutions, but you cannot feed many difficult feeding cases by this method. *In each case you have to size up the circumstances and the people.* Some people will not take the trouble to take off the cream, skim the milk, and mix it up. The other method is easier, and if I am dealing with ignorant people I tell them to use this method of whole-milk dilutions.

In feeding a baby you have to decide five things: What percentages are you going to give it? How much are you going to give it in each feeding, and how much in twenty-four hours? How often are you going to feed it? What is the method of milk modification that you are going to use? How many calories is the baby getting; is he getting *enough* fuel to make him gain?

LECTURE II

THE MODIFICATION OF MILK

JUNE 12, 1916.

As an introduction to the lecture today, which deals with the modification of milk and the calculation of percentages and calories, I can do no better than to quote some words of Dr. John Lovett Morse, of Boston:

"In approaching the subject of artificial feeding, it must be remembered that there are only a few food elements. A baby's food may contain all these elements, it must contain some of them, it cannot contain any other elements. These food elements are fat, carbohydrate, protein, and salts. It must also be remembered that a baby in order to thrive and gain, must have a sufficient *amount* of food. The amount of food, in considering its fuel value, is not calculated, however, in *ounces* or *pints* of food, but in food values, or calories. A baby must receive a sufficient number of calories in proportion to its body weight. Otherwise it cannot gain. It is not sufficient, however, for a food to contain a sufficient number of calories; it must also contain a sufficient amount of protein to cover the nitrogenous needs of the baby. It must further be remembered that a food may contain enough calories and enough protein to cover the caloric and protein needs of the baby, and yet not be a suitable food for any baby, or if suitable for one baby, not for another.

"It is *absolutely necessary* to fit the food to the digestive capacity of the individual infant. These fundamental principles must be always borne in mind in feeding babies artificially. If they are forgotten, the result is likely to be failure rather than success."

You will remember that I said at our last lecture that there were two methods of milk modification we were going to consider:

1. The "gravity" cream and skim milk method.
2. The "whole" milk dilution method.

I also said that there is more trouble to the first method, but that it is likely to give better results in difficult feeding cases—and that the second method is a good deal simpler to use and more applicable for most patients, especially when they are not intelligent enough to carry out the first method.

Gentlemen, I know that all the figures and formulas we are going to talk about may seem complicated to you, but I want to say right here that baby feeding is a mighty fussy job, and that you have got to put yourself to a little trouble if you are going to succeed in it.

First, let us consider the gravity cream and skim milk method. Gravity cream is all the cream that is visible on a quart bottle of milk that has stood about six hours. Skim milk is what is left.

Gravity cream has the following composition:

Fat	16.00%
Sugar	4.50%
Protein	3.20%

Skim milk has the following composition:

Fat	.00%
Sugar	4.50%
Protein	3.20%

I am not going to speak of the way in which to take care of the utensils used in milk modification—you can get this in any text-book—but will merely say that *the thing of greatest importance is to have all utensils as clean as possible*. There are a number of ways of getting the cream off from the skim milk, the most practical of which are pouring and dipping. Pouring is simplest, but not very accurate, and if you are dealing with a family who will take the trouble, it is best to have them remove the cream with a small dipper.

Now, suppose we want to prepare a certain formula, let us say:

Fat	3.00%
Sugar	6.00%
Protein	2.00%

A 32-oz. mixture, the lime water in the mixture to be 25% of the skim milk and cream used.

How much cream do we use?

We want 3.00% of fat—all the fat is coming from the cream, therefore $\frac{3}{16}$ of our mixture will be cream.

$$\frac{3}{16} \text{ of } 32 = 6.$$

$\therefore$ 6 oz. cream will go into our mixture.

How much protein did we put in *with* the cream?

$$6/32 \text{ of } 3.20 = .60\%.$$

But we want 2.00% of protein.

∴ We want 14.0% more protein. This comes from the skim milk.

We want 1.40 of 32 = 14 oz.

$$3.20$$

Then we put into our mixture 14 oz. of skim milk, giving us 20 oz. in all so far.

How much sugar did we put in with this cream and skim milk?

$$20/32 \text{ of } 4.50 = 3.00.$$

We need 3.00% more sugar, as we wanted 6.00% of sugar in our formula. The deficit is made up with dry milk sugar. $\frac{3}{100}$ (3%) of 32 oz. is what we want. This equals 1 oz.

A rounded tablespoon of milk sugar equals $1\frac{1}{2}$ oz. Then we put in two rounded tablespoons of milk sugar. We wanted our lime water to be 25% of the milk and cream used.

$$25\% \text{ of } 20 = 5.$$

Then we need 5 oz. of lime water.

We now have:

Gravity cream	6 oz.
Skim milk	14 oz.
Lime water	5 oz.
Water	7 oz.
Milk sugar	two rounded tablespoonfuls.

I know that all this seems very complex, but you will not have to figure out all your modifications this way, as I can show you a number of short cuts which will simplify matters greatly.

But it is very important to *know how* to do this calculation, even if you don't use it much. The calculation is just the same for any formula, and any desired formula may be calculated by using this one as a model. The

advantage of knowing the method of calculation is that no complicated tables are necessary.

It is often of importance to calculate backwards, that is, if you know that a certain number of ounces each of skim milk, gravity cream, and milk sugar are being used—how are you going to find out what percentages you are getting? Let us say we are using this formula:

Gravity cream	8 oz.
Skim milk	20 oz.
Water	20 oz.
Milk sugar	4 tablespoons.
	48 oz. = total mixture.

Then—

$8/48$ of 16.00 = 2.6 fat.
 $28/48$ of 3.20 = 1.8 protein.
 $28/48$ of 4.50 = 2.8 sugar went in with the skim milk and cream.
 4 tablespoons (2 oz.) of sugar = about 4.00.

Then we have, fat, 2:16; sugar, 6.8; protein, 1.8.

SHORT METHOD

Now, it certainly is a good deal of trouble to go to all this figuring every time you feed a baby, and it is not necessary, usually, for there are certain short cuts which will enable you to figure the amounts of cream and milk needed, much more quickly.

These are as follows:

In a 16-oz. mixture the number of ounces of gravity cream you are going to need always equals the fat percentage desired, and the number of ounces of skim milk *and* cream you are going to need always equals five times the percent of protein desired.

Thus, let us say that you wanted a mixture of 16 oz. to contain

Fat	3.00%
Sugar	6.00%
Protein	1.80%

Then you would need 3.00 oz. of cream.

1.80 (protein per cent $\times 5$) = 9.00 oz. milk *and* cream.

This means 6 oz. milk, for $9 - 3 = 6$.

The only actual calculating you have to do is for the sugar. You have used 9 oz. of milk and cream in a 16-oz. mixture. Therefore, you have put in

$$\begin{array}{r} 9.00 \text{ of } 4.50\% \text{ of sugar} = \text{about } 2.5\% \text{ sugar.} \\ \hline 16.00 \end{array}$$

You need 3.5% *more* sugar.

$$\begin{array}{r} 3.5 \text{ of } 16 = .56 = \frac{1}{2} \text{ oz. sugar} = 1 \text{ rounded table-} \\ \hline 100 \text{ spoon.} \end{array}$$

Or, instead of calculating, refer to the sugar table below.

This method simplifies the whole procedure a great deal, as you can easily see.

In a 16-oz. mixture, you will remember, the figure to multiply the fat percentage by to secure the required number of ounces of cream is 1, and the number to multiply the protein percentage by to secure the number of ounces of milk *and* cream is 5.

There are similar figures for different mixtures, which are as follows:

24 oz.	Fat factor 1.5	Protein factor 7.5
32 oz.	Fat factor 2.0	Protein factor 10.0
40 oz.	Fat factor 2.5	Protein factor 12.5
42 oz.	Fat factor 2.6	Protein factor 13.1
48 oz.	Fat factor 3.0	Protein factor 15.0

You will see that it is a great deal easier to figure modifications by this table than by calculating them out as I first showed you, and if you have a little card in your pocket with the different fat and protein factors for various mixtures on it, it is a very simple matter to figure out any modification in a very short time. This covers the gravity cream and skim milk method of modification.

Now, let us turn to the whole-milk method; that is, simply diluting whole milk with water and adding milk sugar. The "long way" of calculating is just the same as for cream and skim-milk mixtures. Practically speaking, it is a good deal simpler to use a table, as follows:

In any whole milk and water mixture, if $\frac{5}{16}$ of the mixture is milk, that is, 5 ounces of milk in a 16-ounce mixture, the percentages will be:

Fat	1.25
Sugar	1.48
Protein	1.09

Similarly, if more milk is added:

6/16 = Fat 1.50	Sugar 1.75	Protein 1.30
7/16 = Fat 1.75	Sugar 2.00	Protein 1.50
8/16 = Fat 2.00	Sugar 2.25	Protein 1.60
9/16 = Fat 2.25	Sugar 2.67	Protein 1.95
10/16 = Fat 2.50	Sugar 2.96	Protein 2.18
11/16 = Fat 2.75	Sugar 3.25	Protein 2.40
12/16 = Fat 3.00	Sugar 3.56	Protein 2.62

The amount of sugar necessary to add to bring the sugar percentage up to the amount desired can be easily calculated, or still more easily determined roughly by referring to the following table:

1 level tablespoon of sugar raises the sugar percentage

2.00% in a 20-oz. mixture.

1.20% in a 32-oz. mixture.

1.00% in a 40-oz. mixture.

.80% in a 48-oz. mixture.

One drachm of sugar added to 8 oz. of milk raises the sugar percentage 1.5%.

The table of whole-milk dilutions is calculated on the basis of sixteenths. Of course, if you are dealing with a 32-oz. or 48-oz. mixture, multiply the fraction $\frac{5}{16}$ or $\frac{6}{16}$, etc., through by 2 or 3, as the case may be; that is, $\frac{5}{16}$ is the same as $\frac{10}{32}$ or $\frac{15}{48}$.

If a baby is being fed on a whole-milk and water dilution, and you want to know what percentage he is getting, you can easily calculate it as follows:

Say he is getting a 48-oz. mixture:

Whole milk 36 oz.

Water 12 oz.

Milk sugar 4 rounded tablespoons.

Then, as whole milk contains 4% of fat,

$\frac{36}{48}$ of 4.00 = 3.00% fat in the mixture.

$\frac{36}{48}$ of 4.50 = 3.3 % sugar in the mixture.

$\frac{36}{48}$ of 3.20 = 2.40% protein in the mixture.

4 rounded tablespoons of milk sugar added = 2 oz.

$\frac{2}{48}$ of 100 = about 4.00% dry milk sugar added.

So much for the calculation of percentages. As you can see, the "whole-milk" method is considerably more simple to use than the gravity cream and skim-milk method, and it will probably be the more practical one for you to use most of the time.

Now for the calculation of the calories. You may have as many percentages as you like in your mixture, *but if your baby is not getting enough to eat*, they do not do him much good. Most ordinary babies require about 50 calories per pound of body weight in order to flourish. This varies a great deal, of course, in different babies. If a baby is gaining right along and doing well, there is not much use in figuring out his calories. You know he is getting enough to eat from the simple fact that he is gaining weight. If he is not gaining, however, it is advisable to calculate out the caloric value of his food, and it can be done very easily by the following simple formula:

$$(2F + P + S) \times 11\frac{1}{4} Q = \text{Total calories.}$$

F = The fat percentage of the food.
 P = The protein percentage of the food.
 S = The sugar percentage of the food.
 Q = The twenty-four hour quantity of the food.

To a man who has not been brought up in the method the use of so many figures and calculations may seem extremely complicated; but, as I have said before, gentlemen, the feeding of a baby who is not doing well is a fussy proposition, and a good deal of time and thought must be given to it if good results are to be obtained; and I am perfectly sure that after you have used these methods for a while you will have no trouble whatever with them. At the next lecture we will take up the feeding of the premature and normal baby, and a discussion of the various proprietary foods.

LECTURE III

THE FEEDING OF NORMAL INFANTS THE PROPRIETARY FOODS PREMATURE INFANTS

JUNE 19, 1916.

I am going to take up today the feeding of normal babies and normal children, then a discussion of the various proprietary foods, showing their advantages and disadvantages. After that, if there is time, we will discuss the feeding and care of premature infants.

You will remember that breast milk contains 4 per cent fat, 7 per cent sugar, 1.60 per cent protein. It is reasonable to suppose that most normal babies will do well on a milk somewhat approximating this composition. *You do not try to imitate breast milk, however, because what you do is to fit the milk to the individual baby's digestive capacity, determining this capacity by watching the baby's symptoms and by carefully examining the stools.* The feeding of any baby is experimental for the first feeding, *i. e.*, when you first put a baby on any given formula, whether he is sick or well, it is more or less in the nature of an experiment. You know about what a baby of that age and size should take, but you have had no experience with this individual baby, so you give him what you think he ought to have, and if he cannot digest that, you have to adjust his food to what he can take. It is very important in all artificial feeding to fit the food to the baby. The baby, and not rules and tables, ought to be followed in artificial feeding. Remember the individual baby and certain broad general principles which apply to all babies.

The feeding of sick children is a different proposition from feeding well children. Often you cannot get the sick child to take a milk that is anything like the milk a normal child would take. You cannot attempt to imitate breast milk for such cases, but more than ever you have to fit the food to the particular digestive and absorptive power of the individual baby.

How often are you going to feed a baby, how strong a food are you going to give him, and how much are you going to give him at a time, and how much in the twenty-four hours? As I said last time, this varies a great deal for different babies. Two babies of the same age, size and weight may take entirely different amounts and strengths of food, and may need entirely different intervals. Especially is it true that two babies of the same size and weight, but of different ages, will need different foods. The older baby will need a great deal more food and stronger food than the younger baby. In general, an older baby needs more calories per pound of body weight than a younger baby of the same size and weight.

Now, if we were feeding a baby rather small amounts of food, we would naturally give these small amounts more often. If you are giving a large feeding each time, you will be inclined to lengthen the intervals. This table shows what most well babies will take and the most usual intervals employed:

Age.	24° Amount.	Number of Feedings,	
		Amount and Intervals.	
1 wk.	10-12 oz.	10 F of 1 oz. ev.	2 hrs.
		8 F of 1½ oz. ev.	2½ hrs.
4 wks.	20 oz.	8 F of 2½ oz. ev.	2½ hrs.
		7 F of 3 oz. ev.	3 hrs.
4 mos.	32 oz.	8 F of 4 oz. ev.	2½ hrs.
		7 F of 4¼ oz. ev.	3 hrs.
6 mos.	36-42 oz.	6 F of 6-7 oz. ev.	3 hrs.
9 mos.	48 oz.	6 F of 8 oz. ev.	3 hrs.

(From Morse and Talbot's "Infant Feeding.")

COMPOSITION OF FOOD

Age.	Fat.	Sugar.	Protein.
First food	1.00	5.00	.50
First week	2.00	6.00	.75
1 month	3.00	7.00	1.20
2 months	3.00	7.00	1.60
4 months	3.00	7.00	1.80
6 months	3.50	7.00	2.25
8 months	4.00	7.00	2.50
1 year	4.00	4.50	3.20

(whole milk)

As to night feedings, most babies, or at least a great many babies over four or five months old, will get along without any night feedings, taking their feedings from six in the morning to nine or ten at night, and going through the night without any feeding until the next morning. In general, it is a bad plan to allow the baby to take two or three night feedings unless there is some special indication. If you have an atrophic, small baby, not doing well, of course you will probably have to feed him through the night. But it is a good plan to do away with the night feeding if you can, because it saves so much trouble to the parents, and most babies can get along without any, or if they require it at all they can get along with one feeding instead of two or three.

Let us take up again the different elements we have in the food. First, let us consider the *fat*. It is always unwise to feed any baby, no matter how old, on more than four per cent of fat. That is the limit of fat tolerance for practically every baby. You will find that most babies will not be able to take even this amount. Most of them, until seven or eight months of age, will get along better on three per cent than on four. Some babies will get along better on two per cent than on three. You will have more trouble with the fat in the milk than with any other elements. More babies have chronic digestive disturbances from a difficulty of fat absorption than from any other cause.

It is important to consider what per cent cream you are using in making up the milk, if you use the gravity cream method. You cannot use a thirty-two-per-cent cream or a twenty-per-cent cream and calculate as though it were a sixteen-per-cent cream, because the baby may be getting six or seven per cent fat when you want him to get four per cent. In calculating fat percentages it is well not to give any baby over three per cent of fat when using the gravity cream and skim-milk method, because the skim milk inevitably contains a small per cent of fat, and the fat percentage will be higher, in using this method, than you think it is.

Also, throughout this particular district of North Carolina there seem to be a great many Jersey cows, or cows of part Jersey blood. It must always be remembered that Jersey milk is richer in fat than other milks are, and for this reason, if the milk of a Jersey cow has

to be used, it is well to remove part of the cream before making up your milk modification. The milk from a mixed herd is likely to be much more uniform in composition than is the milk from one cow, and this is why it is usually best to feed a baby on milk from a mixed herd, if you can obtain it.

Some babies who cannot take milk fat well are able to take olive oil, and in such cases it is well to give a teaspoonful of olive oil three or four times a day rather than give so much fat in the milk. Rubbing the baby with oil does not do much good, because there is practically no absorption through the skin. This merely keeps the skin in good condition and does not act as a food for the baby.

Recently there has come into use what is called homogenized milk. It is made by intimately mixing olive oil and skim milk by forcing them through a valve under considerable pressure. The oil globules are broken up and made very small, and this milk is often much better digested than any other in certain cases of chronic fat indigestion, where the baby cannot take the milk fat. I am sure this milk will be available to everybody in a few years, but it is not at present, so this for you gentlemen now is a matter of theoretical interest rather than of practical importance.

Let us consider next the *sugar*. There are a number of different sorts of sugar. There is lactose, or milk sugar; sucrose, or cane sugar; and maltose, or malt sugar. These are the three sugars you will use in practical infant feeding. Ordinary lactose, or milk sugar, is the best for feeding most normal babies. It may be split up in the intestine into acids, and when it ferments is likely to be rather laxative. Sucrose has ordinarily no advantage over lactose except that it is cheaper. Generally it is better not to feed babies on sucrose if you can help it.

Maltose is never given pure. Pure malt sugar is very expensive and hard to obtain. Malt sugars and the various malted foods consist of part dextrin and part malt sugar. Some of these preparations which we must consider are as follows:

	<i>Composition.</i>	
	<i>Maltose.</i>	<i>Dextrin.</i>
Meade's Dextrin-Maltose	51.0	47.0
Mellin's Food	58.0	20.0
Maltine Malt Soup		

Meade's Dextri-Maltose is a very excellent preparation. It is not really a "proprietary" food, because it is nothing but a sugar, is not advertised as a complete food, and should never be used as such. You will find it of particular value when a baby has a tendency to fermentation of sugar, because maltose and dextrin ferment much less readily than milk sugar or cane sugar, as maltose and dextrin are absorbed very quickly from the intestine and thus do not have much chance to ferment. Always this is the best sugar to use in feeding a case of convalescent fermentative or infectious diarrhea, when there is a good deal of fermentation going on in the intestine and you want to lessen it. It is also of especial value in certain hard feeding cases because it is absorbed much more quickly than the other sugars and most babies can take a greater amount of this than of the others without developing a sugar diarrhea. Dextri-Maltose has a tendency to cause constipation.

Mellin's food you all know, and for practical purposes it is very much the same as the other, except that it is laxative and contains a certain amount of protein in addition to the sugar.

"Maltine Malt Soup" is a preparation made by the same company which makes the other "Maltine" preparations, and in certain cases is of considerable value. It is a thick liquid, and looks just like molasses, its chief value being that it is very laxative and is very easy of absorption. It is used the same as a sugar is used, and two or three tablespoonfuls of this preparation added to the baby's daily feeding, in place of part of the milk sugar, will sometimes do a great deal to correct constipation. It is also often mixed with modifications which contain starch, the mixture is cooked, and the resulting product called "malt soup." This is sometimes of value in feeding babies who are not gaining.

It should be distinctly remembered that these three preparations—Meade's Dextri-Maltine, Mellin's Food, and Maltine Malt Soup—are not and never can be complete foods, and that their proper role in infant feeding is as substitutes for lactose—when substitution of a malt sugar is indicated.

Horlick's Malted Milk, I should say, may be used in about the same way as Mellin's Food, although it contains more fat and less sugar.

Now let us take up *starch*. It has been proved a good many times that newborn babies can digest starch, but you would not ordinarily feed them on starch, because in practical use starch in any considerable quantity does not agree with them. I always start giving barley water in the milk when the baby is about six or seven months old. It gives him a little more nourishment, it teaches him how to digest starch, and aids in the digestion of milk casein by tending to prevent the formation of large curds. Robinson's Barley Flour is ordinarily what is used. If you take a tablespoonful to a pint of water you get a 1.5 solution of starch. The best amount to use ordinarily is about .75 starch in the milk mixture.

"Barley jelly" is of very great value in infant feeding; it consists merely of a very thick barley gruel, and may be prepared as follows: Add four tablespoonfuls of barley flour to a pint of water, cook in a double boiler one hour, strain to get rid of lumps, add enough water to make up to a pint again, salt to taste, and set on ice. The resulting product is a very thick gruel, and is fed to babies eleven or twelve months old. It is especially of use as the first semi-solid food after infectious diarrhea.

"Oatmeal jelly" is also of considerable value, especially in feeding constipated babies over a year old. It is prepared as follows: Oatmeal, 4 oz.; water, 1 pint. Boil four hours in a double boiler. Add water to form a thin paste. Force through a colander while still hot to get rid of coarse particles, and salt to taste.

The *protein* in the milk is very important because it is a tissue builder. It keeps the baby's body in a state of nitrogenous equilibrium, and any baby has to have it to keep well. The chief trouble with the protein in cow's milk is that it forms large curds in the stomach which are hard to digest. Generally you have very little trouble with the protein in the milk, because you can always modify it and prevent the formation of curds. One way to do this is to give whey mixtures instead of casein mixtures. Whey has this composition: Fat, .00; sugar, 4.50; protein, .90, and all the protein is in the form of "whey" protein, which is very easily digested and is not coagulated in the stomach. So, if a baby vomits and does not digest fat and protein well,

you can use whey and most babies can easily digest it. A good many babies are able to take whey when they cannot take anything else; but it should be remembered that whey is a very weak food and furnishes little nourishment to the baby, so is of value only as a temporary and not as a permanent food. If it is desired to increase the food value of whey, fat may be gradually added to it in the form of 16% cream.

Whey is prepared as follows: To one pint of lukewarm milk add two teaspoons of Fairchild's essence of pepsin, stir and mix. Let it stand until the milk has "jellied," and then beat it with a fork to separate the curd into fine particles. Strain—best through cheesecloth. The liquid which comes through is the whey. One quart of milk furnishes about twenty-four ounces of whey.

Some of the other methods for preventing the formation of large curds are as follows:

1. Addition of cereal diluents.
2. Boiling.
3. Peptonization.
4. Addition of alkalis.

1. The addition of a *cooked starch preparation*, such as barley water, to a milk modification, tends to prevent the formation of large tough curds in the stomach. About .75 per cent of starch in a mixture is enough to give this action.

2. *Boiling milk* vigorously for five or six minutes produces certain chemical changes which to some extent prevent coagulation.

3. *Peptonization* of milk prevents the formation of a curd in the stomach, and also, to a certain extent, predigests the milk. Milk should always be peptonized when being fed by rectum, but usually it is not necessary to peptonize milk for ordinary feeding, because there are so many easier ways of preventing curd formation.

4. The addition of an *alkali*, in sufficient amount, to the milk prevents curd formation. The alkalis which may be used are:

- Limewater.
- Sodium citrate.
- Sodium bicarbonate.

For practical purposes limewater is the best alkali to use, although there is certain evidence to show that the use of limewater interferes somewhat with fat absorption, and in cases where the fat assimilation is poor it should probably not be given.

Limewater must be given in a strength of from 25 to 50 per cent of the milk or milk and cream used in the mixture, if it is to have any appreciable effect. The giving of small amounts of limewater does no good.

Sodium citrate is a valuable alkali to use to prevent curd formation. Two grains of the citrate to one ounce of milk, or milk and cream, is the amount ordinarily used.

Sodium bicarbonate is used in the same strength as sodium citrate, but has this disadvantage: it tends to upset the baby's stomach and may cause him to vomit.

I want to speak briefly of Eiweiss, or protein milk, of which you have all probably heard. The Germans devised this milk a few years ago, in order to get a milk with a relatively high protein and low fat and sugar content for use in fermentative diarrhea. It works very well. The great trouble is that it is very hard to prepare, as you will see from the directions given below, and most people cannot do it satisfactorily.

One quart of whole milk is heated to 100° F. Add four tablespoons of essence of pepsin, and stir. Let it stand at 100° F. until a curd has formed, and strain off the whey from the curd. Press the curd through a fine sieve three or four times. Add one pint of water to the curd and one pint of buttermilk to this mixture.

For all practical purposes it consists then of a pint of buttermilk, a pint of water, and casein from a quart of milk. It contains about 2.5 fat, 1.5 sugar, 3.0 protein. You can use it if you are dealing with an intelligent family who will take the trouble to make it.

If the baby does not take fat well, it is best to skim the milk you use in making the curd.

There is a product on the market which is a good deal easier to use than this Eiweiss milk, and that is called Larosan. It is in the form of a powder, which you can add to a milk mixture to get a high protein percentage. It is a practical thing to use, and a great many babies with fermentative diarrhea will do ex-

tremely well on it. The trouble is that the war has interfered with the production of it, and it is now very hard to get.

Let us consider buttermilk for a moment. It has about this composition: 1 to .5 per cent fat, about 3 per cent sugar, and about 2.5 per cent protein. The protein is in a precipitated form which cannot be coagulated again in the stomach, and there is a very low sugar percentage. There is also lactic acid, which tends to prevent fermentation. These are the advantageous points of buttermilk.

If you are not sure of your buttermilk, and are afraid of getting an impure supply, the lactic acid *cultures* are of great value in preparing lactic acid milk. However, in the tablet form the bacillus may be inactive, so for practical purposes these tablets are sometimes valueless. The best way to get a good lactic acid milk is to have a liquid culture and make your own milk by adding a certain amount of the so-called "starter" to milk and letting it ripen. If you are treating a lot of babies with it you can let it run along from day to day by taking a few tablespoonfuls and putting it into a quart of milk for the next day.

Buttermilk is often a very valuable thing to use in feeding babies, but the trouble is that you cannot tell whether it is good buttermilk. It may be full of all sorts of other bacteria besides the lactic acid bacteria. If you make it yourself, however, you are sure of getting pure lactic acid milk.

PROPRIETARY FOODS

The proprietary foods have certain good points, and a great many bad points. Of course, in certain districts where you cannot get cow's milk, the proprietary foods have to be used; but in general the indiscriminate use of proprietary foods has done more harm than good, because they are usually prescribed without any knowledge whatever of their composition. Most of them are of such composition that they do not give a baby a well balanced ration, and may be of value to add to milk modifications, *but not to use as a complete food*. Most of the babies fed on condensed milk for a long time are small, flabby, weak babies, with little resistance to infection. Proprietary foods cannot contain anything

that milk cannot contain, and if you know how to modify milk you can put into it anything that is in any proprietary food.

If you are going to use a proprietary food, you want to know the composition, or you will not know with what you are dealing. There are four classes of proprietary foods:

1. Condensed milks and evaporated milks.
2. Malted foods.
3. Malted foods containing starch.
4. Starch foods, containing practically nothing but starch.

In class one belong the ordinary sweetened, thick condensed milks and unsweetened evaporated milks. To the second class, malted foods, belong Mellin's Food, Horlick's Malted Milk, etc. In class three is Eskay's Food; and in class four Ridge's Food and Imperial Granum.

The condensed milks have all practically the same percentage composition. The average composition is about as follows: Fat, 9.00; sugar, 55.00; protein, 8.00. You can see that this is a poorly balanced ration for the baby, because there is too much sugar for the fat and protein. When you reduce the sugar to the proper percentage, you reduce the fat and the protein too much, and the baby is not getting enough to eat. If you take one part of condensed milk to two parts of water, you get this percentage: 3.00 fat, 18.00 sugar, 2.6 protein. The fat and the protein would be about right in this mixture for some babies, but most babies cannot take 18.00 sugar for any considerable time without getting into trouble. If you dilute the milk with four parts of water you get this percentage: 1.8 fat, 11.00 sugar, and 1.6 protein. Condensed milk is usually diluted more, and the dilution I have generally seen used is one part of condensed milk to six parts of water. That would give an extremely weak mixture, with very little nourishment for the baby. With eight parts of water the fat would be 1.00, sugar 6.00, and protein .9. The reason why condensed milk is so much in favor is that a great many babies who have been fed on too strong or unmodified cow's milk can take this when it is diluted. Still they are not getting enough to eat, and if you mod-

if cow's milk properly and give them these low percentages they can take it just as well. It is not advisable to feed any baby on condensed milk over long periods of time. Babies fed on condensed milk are very likely to develop rickets.

Evaporated creams have a better composition than condensed milks. The percentage of most of them is this: 9.00 fat, 10.00 sugar, 7.00 protein. If you take one part of milk to three of water you get this: 3.00 fat, 3.3 sugar, 2.3 protein. If you dilute it one to four you get 1.8 fat, 2.00 sugar, and 1.4 protein. You should add milk sugar or malt sugar to evaporated milk dilutions to bring up the sugar percentage. These evaporated milks are immensely better to use than condensed milk, and if you have to feed a baby on canned milk, when you cannot get cow's milk, the evaporated milks are the ones to use.

Horlick's Malted Milk has this composition: 9.00 fat, 67.00 sugar, and 16.00 protein. That is an absolutely unbalanced ration for a baby. If you use it at all you should use it in modifying milk, just as you use milk sugar. Mellin's Food has even a more unbalanced composition. .16 fat, 80.00 sugar, and 10.00 protein, so that it ought to be used as a sugar and not considered as a food by itself. Practically speaking, these foods are valuable things to use sometimes in place of milk sugar, because they are laxative in their action, and malt sugar is very easily absorbed. But you have to know their composition if you are going to use them intelligently.

The third class of foods consists partly of sugar and partly of starch. Eskay's Food consists of 3.5 fat, 55.00 sugar, 29.00 starch, and 6.7 protein. Unless it is used only as a modifier it is practically valueless, because when it is diluted down the baby gets practically nothing but carbohydrates.

Imperial Granum, which belongs to the fourth class, is unfit to feed babies on as an entire food, but may be used in the same way that barley starch is used.

To summarize the condensed and evaporated milks and the proprietary "foods": *Most of them do not contain a suitable balance of the several food elements to allow them to be used as complete foods for any baby;*

they should be used, if used at all, as a substitute for sugar in the modification of fresh milk.

If you know what you are dealing with, and keep in mind the percentage composition of any proprietary food you may be using, you will not get into trouble with it; if you don't know its composition, and use it hit or miss, you may get into a great deal of trouble with it.

This covers briefly the different milk preparations you can give babies, the different sorts you can make yourself, and the different proprietary foods.

When are you going to give a baby solid food? Barley water should be added to the food of most babies at six or seven months of age. When the baby gets to be nine months old, give him a piece of dry toasted bread or zwiebach. When he is ten months old give him a couple of tablespoonfuls of barley jelly through the day, or of farina. At twelve months of age he should be taking whole milk, about a quart a day, and in addition about two to four tablespoonfuls of farina or two or three slices of zwiebach during the day. He can also be given orange juice, and chicken or mutton soup, or beef juice. When he gets to be sixteen or eighteen months old he can take eggs. He should not have them before this, because eggs will often upset a small baby. Start with a teaspoonful of a very softly boiled or coddled egg and increase it gradually. When the baby is two years old he may have finely chopped meat, but no green vegetables before this, and even at this age they should be in the form of a puree, or mashed or well chopped, so that he gets none of the tough cellulose. Mashed potatoes in small amount can be given a good deal earlier, at about fifteen months. *Green fruit of any sort should not be given to any child whatever under five years of age.* I think almost more harm is done by the indiscriminate use of green fruit and improperly prepared vegetables for young children than by any other one thing. Mothers will feed their babies apples, peaches, etc., and the babies get extremely upset. Most babies will get into a good deal of trouble if they are fed any fresh fruit before they get to be five years old. They may take baked apples, stewed prunes, etc., before this. Raw orange juice, and small amounts of raw *scraped* apple also, are perfectly suitable for most babies to take.

The diet list of the Children's Hospital, Boston, for babies of about eighteen months is as follows:

Milk	Milk toast	Baked potato
Butter	Zwiebach	Plain macaroni
Mutton broth	Plain crackers	Orange juice
Chicken broth	Barley jelly	Baked apples
Beef juice	Oatmeal jelly	Stewed prunes
Soft boiled eggs	Cream of Wheat	Baked custard
Dropped eggs	Farina	Corn starch pudding
Stale bread	Rice	Blanc mange
Toasted bread		

PREMATURE BABIES

Now I want to talk for a little while about premature babies. Two things have to be remembered in dealing with premature babies: first, that a premature baby must be kept warm, and, secondly, his digestion is extraordinarily feeble, so he must be given very weak milk mixtures.

Incubators were formerly thought to be of great value in the care of premature babies, but have now been discarded by most pediatricians. A small crib, with padded sides to prevent draughts, is the best place in which to keep a premature baby. There should be a thermometer kept in this crib, and the temperature should be between 90 and 95° F.; the rectal temperature should be taken two or three times a day to be sure that the baby's body heat is kept up. If the rectal temperature varies between 98 and 100° F. there is no cause for any change in the heating arrangements. A premature baby should not be washed with water, but should be oiled with warm olive oil, and wrapped in cotton wool or a gown made of cotton wool between two layers of very soft cheese cloth. It is well not to use any diapers on a premature baby, but to put a pad of cotton wool between his legs, and simply change it when he dirties it. The reason for this is that premature babies bear handling very poorly; the less they are handled the better off they will be. Don't weigh the baby often, it bothers him too much. Once a week is enough. Premature babies seem to get along better if their air supply is moist, so it is of advantage to keep a little alcohol or electric lamp going in the room with a shallow vessel of water over it, to secure the necessary moisture. The

temperature of the room should be about 80° F. A premature baby needs reasonably *clean* air as much as anybody else does, so be sure that the room is properly ventilated, and not kept hermetically sealed to fresh air all the time.

Get breast milk, if you possibly can, for a premature baby. In most cases, of course, you have to get it from some other woman than the mother. If the baby is born at six or seven months, the mother probably will not have enough milk, but if the baby is born nearly at full term, perhaps you can get it from the mother. Give the premature baby very weak food at first. You can scarcely make it too weak to start with. The food on which a premature baby should be started is breast milk, one-half, and a three-per-cent sugar solution, one-half. Give a drachm at a feeding, every two hours for the first twenty-four hours of the baby's life, and start feeding him when he is twelve hours old. The stomach of a baby born at term holds about one ounce, therefore you can judge the capacity of the stomach of a premature baby. If the baby is doing well, taking his food well, and if he seems hungry, you can gradually increase the amount. Most premature babies, if they are doing well, can take undiluted breast milk when from a week to ten days old.

Of course a drachm at a feeding of such a weak mixture as we have spoken of is not enough to cover the caloric needs of the baby; but premature babies do not have digestions which correspond with their theoretical caloric needs, and this is the difficulty. You must feed one of these babies what he *can take*, and not what he *ought to have to get fat on*.

The drachm feedings may be necessary only for the first few feedings, after which the amount may be increased. The amount should be increased before the strength of the food is increased.

If a premature baby is born nearly at term it is possible that he will be able to take the breast, but most of them are too weak to suckle satisfactorily; so it is usually necessary to pump the breast milk and to feed him with a Breck feeder or a large medicine dropper. A Breck feeder is nothing but a big medicine dropper which has a fancy name and costs a dollar and a quarter.

The use of a medicine dropper applies equally to premature babies who are fed on modified cow's milk, as well as to those who are taking breast milk.

It lessens the chances of survival for a premature baby if he has to be fed on cow's milk, but in many cases this has to be done.

The best percentage to start with is fat 1.00, sugar 4.00, protein .50, or you can start him on one-half whey and one-half 4.00 per cent sugar solution, adding a small amount of 16-per-cent cream to give him a little fat, as he gets older.

If premature babies have trouble with their digestions—vomiting or loose bowels—they should not be starved or given a cathartic, as they do not stand either of these procedures well at all. The treatment of indigestion in prematures is to cut down the strength or amount of the food, or to lengthen the intervals of feeding. It is especially important to guard the premature baby against infections of any sort; what might not hurt another baby, such as a slight cold in the head or a mild bronchitis, might prove fatal to a premature.

Prematures need a good deal of water *inside*, but none *outside*. The water should be given between each feeding—the amount being the same amount as the feeding.

What is the prognosis for premature babies? These three facts were brought out from an analysis of 125 cases by Dr. Maynard Ladd. The mortality was sixty-five per cent in babies weighing under four and one-half pounds at birth. A baby under this weight is very likely to die. Second, no child weighing less than two and one-half pounds lived; third, no child at the sixth month of gestation lived.

A premature baby needs an extreme amount of painstaking care. Nothing in the world is harder to take care of, both as to its feeding and as to its general care.

LECTURE IV

DIFFICULT FEEDING CASES—THE VARIOUS TYPES OF INDIGESTION—THE STOOLS IN INFANCY—CONSTIPATION.

JUNE 24, 1916.

I am going to talk today about the feeding of abnormal babies: the different types of indigestion and of nutritional disturbances that you will encounter.

There is no absolutely satisfactory classification of digestive disturbances; the classification which I am going to give you has its faults, but it is, in the main, fairly satisfactory. The basis of it is this: *We look upon the baby's food as being composed of elements, of which we have already spoken many times, and we look upon the disturbances of digestion and nutrition as being for the most part due to an excess or deficit in the food of one or more of the food elements, or faulty digestion or absorption of one or more of these elements when they may perhaps be present in normal amounts in the food. The food as a whole, of course, has also to be considered, as does the proper relationship of the food elements to each other; that is, the baby must have a well balanced food, and one element must not be present in it in great excess, as compared to the others.*

The classification is as follows:

1. Too little food—starvation.

2. Disturbances of digestion.

(1) Acute	{	Too much food as a whole.
	{	Too much fat.
	{	Too much sugar.
	{	Too much protein.
	{	Too much starch.

(2) Chronic.	{	Fat intolerance.
	{	Sugar indigestion.
	{	Protein indigestion.
	{	Starch indigestion.

First of all, let us take up class 1—TOO LITTLE FOOD OR STARVATION. You will see a great many babies who

have not had *enough* to eat, and that is the cause of their troubles. Some of these babies, if the starvation has continued long enough, may present the typical picture of the so-called "marasmus" or "infantile atrophy." These cases are likely to be babies who have been fed on condensed milk or on one of the proprietary foods, or on milk diluted too much, and have been shifted about from one food to another—never doing well on any of them. In consequence, the baby is starved; his digestion is also extremely weak. This is a common type of case. In such cases, first examine the baby carefully to exclude diseases like tuberculosis and syphilis. You have to be sure that the baby is simply a feeding case, rather than that he has any disease, and you should always be suspicious of one of these two diseases in small, very poorly nourished children. Go into the previous feeding history very carefully, and see what the child is taking at the present time and how much he is getting in calories. If the calories he is taking are below par, give him more to eat. That is easy to say, but hard to do, because any baby fed for a long time on an insufficient amount of food has a very weak digestion, *and you have to start on a weak food and gradually increase it*, in dealing with these babies. You will have to go very slowly in raising the fat percentage in the milk when you start feeding babies of this type, because they usually have very poor digestions for fat. Sometimes small doses of nux vomica are of value in these cases, but aside from this drugs are of little aid. The stools should be examined to be sure that there is no indigestion of any particular food element in addition to the starvation. A very important part of feeding any baby who is not doing well is to make careful examinations of the stools from time to time to see if there is any indigestion. That is one of the fundamentals of the method of feeding that I am trying to teach you gentlemen, just this: *In order to feed any baby intelligently you have to strike up some sort of reasonable balance between what goes into and what comes out of him, and you have to be expert in examining babies' stools in order to feed them intelligently. Find out by careful examination what part of the food a baby is not digesting, and then regulate the food supply in accordance with this.*

DISTURBANCES OF DIGESTION may be divided into two classes, acute and chronic. You understand, of course, that all of these types overlap one another. The classification is not absolute, but it makes the subject a little clearer. Let us first consider the acute disturbances.

Too Much Food. A great many babies may be getting too much at a feeding or may be fed too often, or the food may be too rich. As a consequence, the baby's digestion is upset. This type of disturbance is almost always acute, and is manifested by failure to gain, fussiness on the part of the baby, colic, vomiting, and possibly diarrhoea. It is generally wise to clean out the baby at once with castor oil or calomel, then starve him for twenty-four hours, on weak barley water, or water. Start in with a weak food and gradually build up to the limit of his digestion, watching his stools to see that he is digesting the food you are giving him.

FAT. The symptoms of indigestion from too much fat in the food are very much the same as the symptoms from too much food. The vomitus may be creamy and the stools are likely to show a great many small white fat curds, or they may be oily. First, examine the stools to be sure it is an upset from fat, and inquire into the diet. If you find a large excess of fat, cut down the fat in the diet, or cut it out entirely for a few days, feeding the baby on some modification of skim milk without any fat, and increasing the fat one-half per cent at a time until you reach the point where the baby is getting enough fat and not too much.

SUGAR. Most babies will get into trouble if they are having over seven per cent of sugar in the diet. The symptoms of sugar indigestion are vomiting of rather thin, sour material, a good deal of colic and gas, and the passage of frequent, loose, green, acid-smelling movements. These movements, and the whole disturbance, are due to fermentation of sugar in the intestine, with the consequent formation of volatile acids, such as acetic and butyric, irritating the intestine and thus causing increased peristalsis. Sugar indigestion is likely to be more severe than any of these other forms of acute indigestion. Most of the cases will do fairly well with proper treatment, which is to starve the baby for twenty-four hours, starting in the subsequent feeding *with a food very low in sugar*. No castor oil is necessary, for

the baby has cleaned himself out by the diarrhea he is having. After the starvation, go back to a diet with as little sugar in it as possible. It is always best to keep the percentage low for a few days, then very gradually add the sugar again. The sugar which is by all means the best one to use in a case of this type is dextri maltose or one of the other malt sugar preparations, because these have much less tendency to ferment than lactose or sucrose and are absorbed more quickly.

There are no hard and fast lines to be drawn between sugar indigestion and what I call fermentative diarrhea, because in most cases of sugar indigestion there is likely to be a good deal of fermentation. We shall discuss this fermentative diarrhea at the next lecture.

PROTEIN. Acute indigestion from *protein* is common. It shows itself by the vomiting of large, tough curds, due to coagulation of the protein in the stomach. Besides this, there is likely to be a good deal of colic and abdominal pain, with or without diarrhea. You are very likely to find hard, large curds of casein in the stools. The stools may be of two sorts, yellowish, or brownish, with these large curds; or of a brown color, loose, with a strongly musty, foul smell, with no curds. The treatment of protein indigestion is to cut down the protein in the milk. Usually in the type where the stools are yellow, with the curds present, this is sufficient to cure the trouble—to starve the baby for twenty-four hours and cut down the protein in the subsequent diet. In the other type, the condition is a good deal more serious, and it is usually best to starve the baby a little longer, giving him a lactose solution of 6 or 7 per cent with starch to .75 or 1 per cent. In the subsequent feeding the sugar in the diet should be kept, relatively, considerably higher than the protein, as there is alkaline decomposition going on in the intestine, and it is desirable to change the reaction of the intestine from alkaline to acid. This is usually the worst type. If tough curds are being vomited or passed in the stools some of the methods which I have mentioned before of making the protein easily digested in the stomach may be used. This condition of protein indigestion usually clears up very well. Most babies will get over it in a few days, with the proper treatment.

I am not going to speak of acute starch indigestion, because it is rare, and chronic starch indigestion is the more important.

CHRONIC INDIGESTIONS

FAT. Babies have more trouble from chronic *fat* indigestion than from any other form of chronic indigestion. It is really not fat *indigestion*, because the fat is digested perfectly, but the soaps which are formed are not *absorbed*. The difficulty is in the proper absorption of the fat after it is digested. The etiology of this condition is not well understood, but it is probably partly due largely to improper feeding in the beginning with high sugar foods, condensed milk, etc. You will see these cases frequently. The symptoms are that a baby does not gain in weight, is fussy and miserable, may have rickets, may vomit a little, and may have diarrhea or chronic constipation, or an alternation of the two. There may be the so-called "soap" stools, very hard, light colored, crumbly, consisting of insoluble soaps. The stools may, again, resemble scrambled eggs, with many small curds, or they may *look* normal, but microscopically show a tremendous excess of fat, none the less. The way to diagnose a fat intolerance in one of these babies is to examine the stools microscopically and see if there is an excess of fat present. The treatment is difficult. These are the hardest cases you have to deal with in infant feeding. Some of them may present the picture of "marasmus." The treatment of the bad cases is to cut out the fat entirely from the diet. If the case is not severe it is usually enough to halve the fat in the diet and gradually build it up again. If severe, it is best to cut it out entirely and make up for the fat deficit by adding sugar, protein, and starch to the diet in sufficient amount to furnish the proper number of calories. This is hard to do, because when you add a large amount of protein or sugar you are likely to give the baby sugar or protein indigestion. Sometimes these babies have to be kept on a low fat percentage for a long, long time, and the condition requires extreme patience on the part of both mothers and doctors. The fat can gradually be increased in the diet, usually not over one-half per cent at a time. The stools should be examined carefully before adding more fat, to be sure

that the baby is taking the fat you are giving him, before increasing it. Sometimes these babies will take olive oil much better than milk fat, a teaspoonful of olive oil being given several times a day, and no milk fat. No absolute rules can be laid down for the treatment of these cases, except to keep the fat in the diet low; aside from this, each case is likely to require different feeding.

SUGAR. Chronic *sugar* indigestion is not so common as chronic fat indigestion. The symptoms are very much the same as in acute sugar indigestion, the passage of loose, green, watery, acid-smelling stools. The baby's buttocks are likely to be red and irritated from the acids in these stools. When you get stools of this kind you may be sure you have fermentation of sugar in the intestine and that the indications are to cut out the added sugar from the milk for a while. Usually these cases are not so chronic as fat cases. Generally, after giving a low percentage for a while, the sugar tolerance will be increased so that you may start feeding sugar again. Dextri maltose is the best sugar to use.

Chronic *protein* indigestion is not very common, and when you see it, it is generally accompanied by the loose, brown, musty-smelling stools. The treatment is to feed a food low in protein and high in carbohydrates.

STARCH. Chronic *starch* indigestion is often seen, especially in older children. In small babies it may occur when over one to one and one-half per cent of starch is being fed in the milk. They usually show somewhat the same symptoms as in fat indigestion except for the stools, which are brown and very gelatinous. If you add an iodine preparation to one of these stools, the jellylike particles will turn blue from the iodine. The treatment, of course, is to cut out the starch and make up the food deficiency with one of the other elements.

Of course, this classification we have been discussing is not at all hard and fast, because when there is fat indigestion there is likely also to be with it some of the other forms of indigestion. Generally one type predominates, however, but the digestion may be also weakened for some of the other food elements.

You will notice that in discussing these nutritional disturbances I have not mentioned the salts. These are,

of course, of very great importance; but we know so little about the metabolism of the salts, and the whole question of their role in nutrition is so complicated, that with the present state of our knowledge we can take them into very little consideration in practical feeding.

Now, I want to talk about chronic fat and starch indigestion in older children. This is a condition you will often see. I have seen a number of cases of this type since I have been here. The usual story is that a child three or four years old is miserable all the time, a typical picture of so-called "atrophy" or "marasmus," to a greater or less degree. *There is no use in experimenting with different foods in these cases until you see what is giving the child indigestion. You cannot feed abnormal feeding cases intelligently unless you carefully examine the stools to see what the child is digesting and what he is not digesting, and by this make your diagnosis and regulate the child's food supply accordingly.*

Fat. In feeding these cases the utmost care is necessary, and it is usually very hard to manage them when the children stay at home, because the parents are likely to give them anything they want to eat. Generally the digestion for every food element is weak, but especially so for fat. For these cases write out an absolutely iron-clad diet list, showing just what the child is to eat in the twenty-four hours. You have to write down the exact amount of everything the child is going to get, and also state what it should not have. The child is to stay on this diet for a long time. Most cases of this sort will take a year or two years before you get them back to normal. Sometimes if a child gets to the table and eats a piece of butter the size of a pea it will completely upset him again. You have to keep the child on a fat-free or a very low fat diet, the diet being made up mostly of starchy food and proteids. As to drugs, it is usually of a good deal of advantage to get these children cleaned out with castor oil once a week, as the intestines may be very sluggish. Nux vomica is also a very good drug to give. For anemia, of course, iron is indicated. Needless to say, have the child get all the fresh air possible and live in a sensible and hygienic manner. You can get excellent results with these cases

if you are dealing with an intelligent family; but if you are dealing with a foolish mother who will not follow your instructions absolutely, you can never do any good among them.

You can, perhaps, get a better idea of cases of this sort by the discussion of a concrete case. This history is of a girl of five years, who entered the Children's Hospital, April 14, 1915, and is a very typical example of chronic fat intolerance.

HISTORY

Past History. Normal delivery. Breast fed for five months. Birth weight, six pounds. After five months breast milk gave out and the child was put on Eskay's Food for a month. After this she was fed on barley gruel and whole milk. She did fairly well up to a year ago.

Present Illness. About a year ago she began to have diarrhea. This diarrhea would last for about a week, then she would apparently be perfectly well for a while, when the diarrhea would return. During the periods of diarrhea she would have 6-8 loose, light colored stools in twenty-four hours, without mucus or blood. Most of the time she has been kept on a fairly careful diet, except that she gets off with the other children occasionally, and gets a good deal of candy, etc. At these times her digestion appears to be especially upset, and she vomits, and the diarrhea becomes more marked. No vomiting at any other time. For the last week she has been so weak she has had to stay in bed, and has been on a diet of bread and milk, beef juice, port wine, and albumin water.

Weight: One year ago, 31 pounds.
Now, 18½ pounds.

Short Summary of Physical Examination. Very poorly developed and nourished. Pale. Skin dry and loose. Glands, moderate general enlargement. Abdomen, very large, tympanitic save in flanks, where there is shifting dullness. No fluid wave. No masses, spasm, or tenderness.

Stool, brown, hard, smooth, alkaline, no mucus. Microscopically shows a large excess of neutral fat and soaps. No starch.

This girl was treated as follows:

She was at first kept in bed, as she was too weak to stand. These drugs were given:

Tincture nux vomicaminims V. t. i. d.
Saccharated oxide of iron.....gr. V t. i. d.

Castor oil was needed about once a week, as she had a good deal of distention at times, and a thorough cleaning out occasionally seemed to help her a good deal.

The diet was scanty at first, but was gradually increased as she grew stronger.

April 15th she took

Zwiebach	3 slices.
Beef juice	2 ounces.
Cereal (farina)	3 tablespoons.
Fat-free milk	24 ounces.

She improved rapidly, and was soon strong enough to be up and around the ward. The stools varied a good deal. Sometimes they were hard and constipated, sometimes they looked normal, and sometimes they were very loose and foul. The fat was never in excess while she was on the low-fat diet.

May 9th she was taking:

Cereal (farina)	1 tablespoon.
Bread (stale)	2 slices.
Zwiebach	3 slices.
Beef juice	3 ounces.
Chopped meat	1 ounce.
One egg.	
Juice of half an orange.	
Apple sauce	2 tablespoons.
Fat-free milk	24 ounces.

She was kept on practically this same diet until she was discharged, very greatly improved.

Her weight at entrance was 18 pounds 4 ounces.

Her weight at discharge was 24 pounds 8 ounces.

Average gain per week, 9 ounces.

I have not happened to see this particular girl since she left the hospital, but it is certain that if her mother has not dieted her strictly she is in just as bad condition as she was before she entered the hospital. If her mother takes pains to diet her carefully, she will probably get along very well.

STARCH. The symptoms of *starch* indigestion are very much the same as those of fat indigestion. The stools are different, being brown and loose, with a great deal of jellylike material. There is also likely to be a great deal of cellulose in the stools. If you examine into the diet you will likely find that the child eats a tremendous amount of starch in the form of hot bread, potatoes, etc., and that it also eats a good many green vegetables and fruits. The child eats too much starch and cannot digest it, and the great amount of cellulose going through the intestine irritates it and causes diarrhea. The thing to do in these cases is to cut out the starch as much as you can. Of course you cannot cut it out entirely, because children of this age depend

so much upon cereals. However, you can cut it down, and you can cut out the coarse vegetables and fruits. You can also have the starch thoroughly cooked. Any cereals these children take should be cooked over night. The diet list should be written down. It can be practically the same from day to day, for most children do not at all mind a monotonous diet. The essential things are to feed a low starchy, thoroughly cooked diet, cut out the fruit and coarse green vegetables, and to have all the food the child takes in as finely divided a form as possible.

THE STOOLS IN INFANCY

There are a few points I want to discuss about the stools in infancy. The subject is worth a great deal more time than I am giving it, but it is so well discussed in Dr. Morse's "Case Histories," your text-book, that I am going to merely emphasize certain important points.

The examination of the stools is of very great importance, both macroscopic and microscopic, and usually altogether too little attention is paid to it. It is perfectly obvious to any one that it is a rational and sensible thing, when you are dealing with a baby who has indigestion, to carefully examine his stools and get as much information as you can from this source.

The reaction of the stools is sometimes of considerable importance. In the infant's intestine two processes are continually working against and counter-balancing each other: decomposition of fat and carbohydrates, with acid end products, and decomposition of protein, with alkaline end products. These two processes, under normal conditions, just about balance each other, so that a normal stool is either slightly alkaline, neutral, or slightly acid in its reaction. If the intestinal contents are too strongly acid or too strongly alkaline, trouble usually results, due to the irritant action in the intestine of the acid or alkaline end products.

Some of the various types of abnormal stools seen are as follows:

1. *Fat Indigestion.* The stools in this condition may be of a number of types:

1. The "scrambled egg" stool, acid smelling, loose, and with many fine soft white fat curds scattered through it.

2. The "soap stool," usually a hard light colored, rather dry and crumbly stool—sometimes almost white. Typical soap stools are made up very largely of insoluble calcium and magnesium soaps.

3. The oily stool. Sometimes in cases of fat indigestion the stool may be a light yellowish-brown color and very oily.

4. Some stools which contain a large excess of fat may look perfectly normal macroscopically, but when examined under the microscope will be seen to contain a large excess of fat. These stools are usually of a salve-like consistency.

2. *Sugar Indigestion.* The stools of sugar indigestion are always strongly acid in reaction. They are usually loose, green, strongly acid smelling, and may contain fat and casein curds, due to the fact that the stool has been hurried through the intestine so fast that the fat and casein have not had time to be absorbed. The stools of mild sugar indigestion may sometimes closely resemble the "scrambled egg" stools of fat indigestion previously described.

3. *Protein Indigestion.* The stools of protein indigestion may be of two types. The first type is usually yellowish or light brown, and contain casein curds which are smooth, tough, white, bean-shaped masses of coagulated casein. The second type is brown, loose, foul, strongly alkaline in reaction, and may be frothy or bubbly. This type of stool indicates that there is considerable decomposition of protein going on in the intestine.

4. *Starch Indigestion.* The stools of starch indigestion are usually loose or pasty, rarely smooth or homogeneous, are brown in color, and are likely to contain small brown mucilaginous masses of partly digested starch, together with a good many coarse, cellulose remains, such as seeds, pulp of fruit, etc.

The microscopic examination of the stools is important. By microchemical methods we test for fat or starch.

The technique of the fat test is as follows:

Place a small portion of the stool on a glass slide, add a drop or two of glacial acetic acid, and a drop or two of a saturated alcoholic solution of "Soudan iii" stain. Rub up the stool, acid and stain together, and heat gently for a moment over an alcohol lamp. Examine with the low power of the microscope: the fat

shows itself as small orange-red globules. Nearly all stools contain a fair amount of fat, and whether or not the fat is in excess in any given stool preparation can be told only by a certain amount of experience with the method. If a baby is doing well in every way, it is not necessary to change the food if you find a slight excess of fat in the stool.

This method, used in this way, gives the *total fat* in the stool, and does not differentiate between neutral fat, fatty acids, and soaps. What you want to know in most stools is the total fat content, so I will not go into the technique for the differentiation of soap, etc.

The test for starch is simpler:

Add a drop or two of official tincture of iodine diluted 1 to 15 with 95 per cent alcohol to a small portion of the stool, and examine under the microscope. Starch granules stain dark blue. It is abnormal for there to be any but the very smallest amount of starch in a stool.

CONSTIPATION

I will finish the lecture by talking very briefly about constipation. Constipation in small babies and in children during the second year is an extremely common condition and one hard to deal with. There may be a number of causes. The first is mechanical. The large intestine is relatively a good deal longer in a child than in an adult. The sigmoid flexure is longer and the mesentery is longer. There are thus a good many chances for kinks in the intestine, which may partially obstruct the passage of stools. It is well to bear in mind that this is certainly sometimes the cause in some of the severe cases.

There are a great many other causes, too, but we need not go through all, and will take up only the two most important. The first is atony of the abdominal muscles and intestine; the second is the character of the food.

In a great many babies constipation may be caused by the very flaccid condition of the intestines and abdominal muscles. The child has not enough strength in his abdominal muscles to strain down and force out the feces. The abdomen is very flabby. Of course, the treatment of such a case as this is to increase the general strength and well-being of the child, if you can. Nuxvomica is usually a very good drug to use. In an older

child exercise of the abdominal muscles is very valuable. Of course, if there is anemia or any diseased condition, iron is indicated for the anemia and suitable drugs for the other conditions.

Constipation may be caused by either too little or too much fat in the food. If the food is very low in fat, there is likely to be so much of the food absorbed that not enough is left in the intestine to cause a good movement of the bowels. If there is too much fat in the food, constipation may be sometimes caused by the formation of hard, dry "soap stools."

These are the most usual causes of constipation.

What are you going to do for a case of constipation? First, let me say that in a good many cases, no matter what you do, the results are poor.

1. *Diet.* The diet is of great importance. If you are feeding the child on cereal or cereal waters, oatmeal is the best one to use, as it is somewhat irritating to the intestine, and will help to cause peristalsis. If the child is not getting enough fat, give him more—if he is getting too much, cut it down. Properly prepared green vegetables are of value, chopped up spinach, celery, or carrots being very good. Orange juice or prune juice or finely scraped apple will sometimes help.

The malt sugar preparations, such as maltine malt soup, are often of great value, as maltose is very laxative, and sometimes obstinate constipation in a small baby can be corrected by substituting malt for milk sugar without any other measures.

2. *Drugs.* In the atonic cases, tincture of nux vomica is sometimes of great value, and may do more good than either diet or cathartics.

Iron is indicated if the child is anemic. "Esen-zucker" (saccharated oxide of iron) is the best preparation to use, as some of the other iron preparations have a tendency to cause constipation.

3. *Cathartics.* Use cathartics as little as you can in the treatment of constipation; they may relieve the condition for a while, but do not get at the cause of it.

Such cathartics as castor oil and calomel should not be used; they are too irritating for continued use.

The best cathartic for small babies is milk of magnesia, and for older babies and children, phenolphthalein, in doses of from 1 to 3 grains.

“Agar Agar,” which is a preparation of finely ground seaweed, may be of value. It is given in doses of a teaspoonful two or three times a day, mixed up with the child’s cereal or potato. Of course it cannot be used for babies who take only milk. It is not absorbed, but increase the bulk of the stool, by swelling, which tends to cause a good movement.

The various mineral oils which are on the market are also of a certain amount of value.

Suppositories are bad to use; as they establish a bad habit for the baby and make him think that he cannot have a movement of his bowels unless previously stimulated with a suppository. If enemas have to be used, plain soap and water ones are the best.

Constipation is a very fussy condition to treat, and requires a good deal of care. I have merely attempted to give a very brief summary of some of its most important aspects.

LECTURE V

DIARRHOEAS OF INFANCY

JULY 1, 1916.

1. Nervous.
2. Mechanical.
3. Fermentative { Carbohydrate form.
 { Protein form.
4. Infectious { 1 { Dysentery.
 { { Streptococcus.
 { 2 Gas bacillus

I am going to talk today about the diarrhoeas of infancy. There is a great deal of difference of opinion among various pediatric teachers and schools about the etiology, nature and treatment of these diarrhoeas, so I have no right to speak dogmatically in discussing such a question, but am going to do so for the sake of clearness.

What is diarrhoea? What causes diarrhoea of any sort? Diarrhoea is caused by increased intestinal peristalsis. That is at the bottom of every diarrhoea, whether it be of a baby or an adult. Increased peristalsis may be brought about by a number of causes, as follows:

1. Reflex nervous influences.
2. Irritation of the intestine mechanically by seeds, skins of fruit, improperly chewed food, etc.
3. Irritation of the intestine by injurious chemical products of food decomposition.
4. Bacterial infection of the intestinal mucous membrane.

What sorts of diarrhoea do you see in infancy? Of course, all diarrhoeas are not the same, and it is not enough to say, in the case of any baby who has diarrhoea, that he has "ileocolitis," or "summer complaint." It is necessary to diagnose the diarrhoea more accurately and determine what type of diarrhoea it is, and to what it is due before it can be intelligently treated, for different sorts of diarrhoea require different treatment.

First of all, there is a NERVOUS DIARRHOEA. Such a diarrhoea as this may be seen at the onset of acute in-

fections, such as pneumonia, scarlet fever, etc. There is no question in such a diarrhœa of any bacterial infection of the intestine. The nervous mechanism of the intestines is upset and increased peristalsis is caused by some focus of disturbance elsewhere in the body, producing diarrhœa. It is sometimes difficult, when you see a case like this, to tell whether or not the diarrhœa is causing the child to be sick, or whether something else, like infection of the middle ear, teething, etc., is causing the diarrhœa. This type of diarrhœa is usually controlled by reducing the food. It is often best, in very hot weather, to weaken the food, and this is also a good thing to do in feeding children with acute diseases, like pneumonia, scarlet fever, etc.

MECHANICAL DIARRHŒA is caused by irritation of the intestine by such things as seeds, skins of fruit, and various sorts of indigestible material. The child's intestine is much more susceptible to irritation of this sort than is that of the adult, and this is why it is wrong to feed raw fruit or coarse green vegetables to small children. There is nothing particularly to be said about this type of diarrhœa. The stools always contain portions of undigested material, so the cause of the diarrhœa is readily ascertained. A diarrhœa of this type is likely to have more gastric disturbance with it than are most of the other diarrhœas of infancy and childhood. The treatment is to thoroughly empty the intestine with calomel or castor oil, to withhold food for twenty-four hours, and then to start in with a weak, easily digested food, keeping the child on a rather scanty diet for a few days, after which the regular diet may be resumed.

FERMENTATIVE DIARRHŒA, the third type, is an extremely common condition. In Boston we see more cases of this type than of any other. Probably most of your cases, too, are of the fermentative type. This is a diarrhœa caused by the abnormal decomposition of food material in the intestine, giving rise to products which irritate the intestinal mucous membrane and cause diarrhœa. *The mucous mebrane is not attacked by bacteria in this condition.* It is simply the food in the intestine that is attacked and decomposed, and the resulting products irritate the intestine and stimulate it to increased peristalsis. Diarrhœa of this type may be of two sorts, the carbohydrate form, in which the carbo-

hydrates in the intestine are the substances that are being decomposed, with the formation of acid end products; and the protein form, in which the protein substances are being decomposed, with alkaline end products. By all odds the most common type is the carbohydrate form, and this is the usual "summer diarrhœa" that is seen in infants. It occurs especially in the summer, and is rarely seen in winter. The etiology may be due to many factors and conditions. It may be due to heat, the child's digestion being upset by heat and the resistance lowered, opportunity being thus given the normal bacteria of the intestinal tract to ferment the carbohydrates there. It may be caused by feeding too high a sugar percentage to the baby. The sugar is not absorbed, and what is left behind ferments. It may be caused by dirty milk, which carries into the intestines all sorts of harmful organisms, the bacillus proteus, the gas bacillus, the colon bacillus, etc. Whatever the organism may be, we know that it usually gets into the intestine by means of contaminated milk. Summer is, of course, the most favorable time for these organisms to develop in milk. If the milk is pasteurized or sterilized, or if it is certified milk, you will not see many cases of this type of diarrhœa, and it is not nearly so common in the better classes, who take good care of their milk, as it is in the poorer classes.

The prominent symptom of fermentative diarrhœa due to carbohydrate decomposition is the passage of loose, *green, acid stools containing mucus. The stools are always strongly acid and smell acid.* They are usually green. The number may vary a good deal—there may be three or four or five in a day, or twenty or twenty-five. The severity of the attack may vary a great deal. The child may appear not to be sick at all, but may have these stools; or there may be a great deal of toxæmia, with high temperature, and the child may die. The temperature rarely is over 101 or 102. There is not a great deal of vomiting, because the condition is primarily an intestinal one and the stomach has very little to do with it. The buttocks are likely to be red and irritated from the strongly acid stools. The abdomen in the severe cases may be sunken, also the eyes and the fontanel. Nervous symptoms are not so common as in true "infectious diarrhœa." You have all

seen so many of these cases, that it is not necessary to discuss the symptoms further.

The *prognosis* of this condition is very good, with the proper treatment, in a reasonably strong baby. If a small, poorly nourished baby has an attack of fermentative diarrhœa, he may die.

The sugar in the intestine is attacked by bacteria and broken down. Formic, acetic and butyric, as well as many other acids, are formed from the breaking down of the sugar. A certain amount of formaldehyde is also likely to be produced. It is surprising to see how much strong acetic and butyric acid may be recovered from the stools of babies with this condition, and when you do see how much concentrated acid is present, it is easy to understand how tremendously the intestine is irritated by it.

Of course, in this condition the absorption of all the food elements is lessened, partly on account of the increased peristalsis and partly on account of the abnormal acidity of the intestine.

TREATMENT: You may be sure in any diarrhœa that if the stools are green, acid smelling, and strongly acid in reaction, the condition is due to sugar fermentation. What are the indications for treatment? *As the condition is due to a sugar fermentation, it is reasonable to give a milk as low in its sugar content as possible, to arrest this fermentation. If, in the food, a high protein content can be combined with this low sugar content, a good deal will have been gained, for the disintegration products of protein are alkaline in reaction, and will help to neutralize the acid condition in the intestine, restoring it to its normal balance. The withdrawal of sugar and the substitution of protein will also tend to inhibit the growth of the bacteria which have been causing the condition.*

These are the principles of treatment.

DETAILS OF TREATMENT: In severe, acute cases, it is usually better to starve the child for twenty-four hours, giving him merely water. In the milder cases, starvation is not at all necessary. As to purgatives, personally I do not at all believe in giving them to cases of fermentative diarrhœa due to carbohydrate, when the child is having ten to fifteen or twenty stools a day, as he is cleaning himself out, and it is not necessary to

clean him out further. The intestine is already very much irritated, and it is poor therapeutics to irritate it any more. But if the child is having only three or four bad looking stools, by all means give him a purge of castor oil or calomel, to clean out the intestine. After the starvation period of twenty-four hours you can start the feeding. There are two or three different methods you can use, but the principle is the same in all. You can start on skim milk and water dilutions, giving the baby such a formula as this: Skim milk, one-half; water, one-half. The percentage is this: Fat, none; sugar, 2.25; and protein, 1.60. Of course, no definite rules can be laid down for increasing the strength of the milk, as this will depend upon the clinical condition. Keep the fat low for a considerable length of time, also the sugar, and go up on the protein. When you do add sugar, use a malt sugar preparation instead of milk sugar. Keep the sugar very low until the stools have become solid.

Another way of feeding these cases is by the use of "eiweiss" milk, of which I have already spoken to you, in the last lecture. This is extremely satisfactory in such cases, and they will get well much more quickly than if you use simply skim milk and water. The disadvantage is that eiweiss milk is hard to make, but if you are dealing with an intelligent family, you can get them to make this milk, and it is by all odds the best thing to feed these cases on, because you can get a much higher protein percentage and a lower sugar percentage than by any other means. Eiweiss milk has this composition, you remember: Fat, 2.5; Sugar, 1.5; Protein, 3.5; or if you use skim milk, instead of whole milk, the fat is reduced nearly to zero.

There is another method; the use of skim milk and water mixtures to which powdered casein has been added. The great trouble about this is that it is hard to get powdered casein. There was a good product on the market some time ago called "Laroson," but I am not sure whether this can be obtained now. Buttermilk is also sometimes of value in feeding these cases, as it combines a high protein with a fairly low sugar content. So much for the feeding.

DRUGS: I do not wish to give the impression that drugs are of no value in treating this condition, but I

distinctly *do* wish to give the impression that the regulation of the diet is by far the most important part of the treatment. It is very rarely necessary to give a drug of any sort to a baby with fermentative diarrhœa.

PURGATIVES: As I said before, purge the baby with castor oil or calomel if he has not already cleaned himself out well; if he is having numerous stools already, give him no purgative. *It is a great mistake to give repeated daily doses of calomel or castor oil to a baby who is already exhausted by diarrhœa.*

BISMUTH: Bismuth does very little good in fermentative diarrhœa, and it obscures the stool picture, so you cannot tell the nature of the stool, and thus cannot regulate the diet intelligently. Proper food regulation will usually stop the diarrhœa, without using bismuth.

OPIUM: Theoretically, opium is contra-indicated, because it is unwise to tie up the intestine, and thus favor absorption of toxic material. Practically, when a baby is having many watery stools a day, with a good deal of straining and tenesmus, with perhaps a prolapsed rectum, it is wise to give opium in some form, usually paregoric, to relieve him.

INTESTINAL ANTISEPTICS: The intestinal antiseptics are of very little value when treating fermentative diarrhœa: if you give enough to sterilize the intestine you give enough to kill the baby. Bulgar tablets, which are so commonly used, are very likely to be inactive.

COLONIC IRRIGATIONS: The trouble in fermentative diarrhœa is usually so high up in the intestine that little benefit is to be obtained from colonic irrigation.

FLUID: It is extremely important to give the baby plenty of fluid, either by mouth, rectum or by subcutaneous injection, if necessary.

ALKALIS: Theoretically it would seem that as the trouble in fermentative diarrhœa due to carbohydrate fermentation is caused by the excessive production of acid in the intestine, alkalis would be indicated. Practically, it is much easier to change the reaction of the intestine by the use of suitable food than by alkalis. In certain cases of fermentative diarrhœa there may be a good deal of acidosis, however, which may be manifested by rapid and labored breathing, by stupor, or by extreme restlessness. If acidosis is suspected, an alkali is indicated. Sodium bicarbonate may be used; either

by mouth or rectum, usually best by rectum, as it has a good deal of tendency to upset the stomachs of small babies.

You will see that I am somewhat of a drug nihilist as regards this condition: to my own cases I rarely give a drug, with the exception of an occasional dose of opium or castor oil. I understand perfectly that a doctor has to give drugs to many people if he wants to keep them as patients, and do not believe that such drugs as bismuth, salol, etc., do any harm.

Fermentative diarrhœa of the carbohydrate type in breast fed babies. Fermentative diarrhœa usually occurs in bottle babies, but you may see it in breast babies. The treatment is to take the baby off the breast for twenty-four hours, clean him out, and feed him water while he is off the breast. After twenty-four hours he can be put back to the breast, but it is usually best to somewhat lengthen the feeding intervals, and to give him two or three ounces of water immediately preceding each nursing—to dilute the breast milk.

These cases will usually not cause much trouble.

In fermentative diarrhœa due to protein, the general symptoms are very much the same as in this type of diarrhœa due to carbohydrates, which we have been discussing, except for the stools. The stools in protein fermentative diarrhœa are loose, watery, brown, and rather musty or foul smelling, and *they are alkaline in reaction*. The condition is due to decomposition of protein in the intestine, *therefore you will treat it by giving milk low in protein and high in carbohydrate*. The first food which it is usually best to give is a three to five per cent solution of milk sugar, to which barley water may or may not be added, keeping the protein low for a while, and gradually increasing the strength of the food by adding skim milk, or whole milk, and more sugar. These cases will usually do well with proper treatment, but some of them may be troublesome. The general treatment is the same as for the carbohydrate form. You will see fifty carbohydrate cases to one of the protein type. The protein type is not seen in breast-fed babies.

INFECTIOUS DIARRHŒA is the type of diarrhœa that most of you see down here. It is called by different names; ileocolitis, dysentery, etc. This condition may be due to a number of organisms, which may be divided

into two groups, the dysentery bacillus and the streptococcus, which I put together because the treatment for them both is just the same; and the gas bacillus group, for which the treatment is different. As you will note, this classification is based on the treatment. The etiology is infected milk in nearly all cases, and if the disease is seen in breast fed babies it means they have been having some food in addition to the breast milk.

First of all I want to speak of the gas bacillus type. There has been a great deal of discussion, especially in Boston, as to just what role the gas bacillus plays in infectious diarrhœa. We find it in a certain number of cases, and we know that when we get rid of it the cases improve a great deal. From that line of reasoning, we consider that in these cases the gas bacillus is the cause of the disease. Some men say that it has nothing at all to do with it, and that it is simply present in the intestine, doing little harm, and that the infection is due to the dysentery bacillus, and that if a man will look for that carefully enough he will always find it. Personally, I think most cases are caused by the dysentery bacillus, but I do believe that a certain number of cases are caused by the gas bacillus. It is important to differentiate them, because the treatment is different for each type. This must be done by stool cultures. Clinically you cannot tell the two types apart except that the dysentery type is likely to be a little more severe. We will speak of the differentiation of the two types a little later.

Let us take up the dysentery type, which is the one usually seen. The trouble is usually in the large intestine and in the lower part of the small intestine. There may be only a catarrhal inflammation present, or there may be small superficial ulcers or deep ulcers. The symptoms may vary considerably according to the severity of the infection. The onset is usually sudden. The stools may vary a good deal in number, as many as twenty or thirty being passed each day. They may be very small, usually only small amounts of blood and mucus, pus and slime being passed after the first day or two. Some cases may show extreme nervous systems, and you may mistake the case for meningitis at the onset. The only way to rule out meningitis is to do a lumbar puncture and examine the spinal fluid. The tem-

perature may vary a good deal, in some cases being very slight, in others very high. The evidences of toxæmia are usually severe, and these children are certainly very sick in most of the cases that you will see. You have all seen so many of these cases that it would be a waste of your time to go further into the symptoms.

As to the treatment: A good many different methods of treatment have been used for the condition. The principle to remember is this: *The dysentery bacillus lives upon protein food much more readily than it does on carbohydrate and the products which it forms from protein are much more toxic than the products from carbohydrate, so feed these cases on a low protein diet and a fairly high carbohydrate, giving the child as much food as he can reasonably take without being upset. Carbohydrate food tends to discourage the growth of the dysentery bacillus—protein food encourages it.* That is the principle of the treatment of cases of diarrhœa due to the dysentery bacillus or to the streptococcus. It is usually best to give these cases an initial purge of calomel or castor oil, then starve them for twenty-four hours, giving nothing but a five or six per cent sugar solution. We used to starve them for as long as ten days at a time, but have stopped that, because we found out that the cases do a great deal better if they are not starved so long. We start the feeding by adding barley water to the sugar solution, then by adding a small amount of skim milk to this. Some of these children do not like to eat, but they have to have fluid and they have to have food, so feed them with a stomach tube if they will not take the milk.

The gastric symptoms are usually not severe, so there will, in most cases, not be much vomiting. If there is vomiting, the thing to do is to wash out the stomach and stop the food for a few feedings.

There are no definite rules that can be laid down for the feeding of these cases. Size up each case and remember the principle of fitting the food to what the individual baby can take, keeping it rather low in protein and high in carbohydrate, and, especially during convalescence, *low in fat*, because the digestion of fat is very poor during the whole course of the disease and convalescence. A prominent pediatrician said last year that he had come to the conclusion that the best way to treat

infectious diarrhœa was to consider a case very much as a case of typhoid fever. This is sensible, for the dysentery bacillus is closely allied to the typhoid bacillus, and the pathology of the two conditions is somewhat the same.

To clinch the question of feeding these cases, let us take a suppositious case and feed it: but remember that this particular feeding I am telling you might apply to one baby, and not to another.

Let us say that our patient is 16 months old, and is seen the first day he is taken sick, and has had four stools with blood and mucus.

1. A purge—castor oil or calomel.
2. Withdraw food for 24 hours, giving plenty of water, 8 ounces every three hours, sweetened with saccharine, if necessary.
3. Start feeding with a solution of 8 per cent lactose, giving water between each feeding.
Lactose solution, 8 ounces every three hours.
Water, 4 ounces between each lactose feeding.
4. After a day of the lactose feeding, add 1 per cent barley starch to the sugar solution. Feed this for a day or two.
5. Feed lactose and starch solution, seven ounces, skim milk one ounce.

Gradually increase the skim milk in this feeding, until when the baby is nearly well he will be taking possibly this:

Skim milk, 6 ounces.
Lime water, 2 ounces.
Dextræ Maltose, 1 drachm.

Soon to this can be added barley jelly, three tablespoonfuls a day, and if he takes this well, powdered zwiebach can be given. The last thing to do is to increase the fat in the food, and this is done by substituting an ounce of whole milk for an ounce of skim milk, until the baby is taking entire whole milk.

Of course this feeding would have to be modified for a younger baby, and you would have to give a weaker milk, but the principle is the same.

As to the rest of the treatment, the most important single thing in the whole treatment is to keep the baby filled up with fluid. If you cannot give it by mouth or by rectum you will have to give it subcutaneously. This is not hard to do. *Do not let these babies get dried out.*

Give them salt solution under the skin right away: a teaspoonful of salt to a pint of water. More babies die from getting dried out in this disease than from any other one thing.

For excessive fever, the best treatment is baths, a sponge bath of one-half alcohol and one-half water, at 80°, or a fan bath, wrapping the baby in cheese cloth, sprinkling it with water and fanning him, or a cold bath at 70°F. Do not give antipyretic drugs, they are all depressants. Some babies have a subnormal temperature and have to be stimulated by hot water bags or hot salt solution by rectum. Colonic irrigation may be of some value in treating the disease, and will do no harm. If it does not disturb the baby, it is a good idea to give one once a day, of normal salt solution or 4% soda bicarbonate solution. In cases that do not clear up well and continue to have pus in the stools too long, it is sometimes well to use a 2% solution of silver nitrate for the irrigation.

DRUG TREATMENT: About the same may be said of the drug treatment of infectious diarrhœa as was said for fermentative diarrhœa.

PURGATIVES: Purgatives are indicated in the beginning of the disease, or during its course if the number of stools drops suddenly and there seems to be a good deal of toxemia. I think it is extremely bad practice to give a purge every day as a routine.

BISMUTH: Bismuth may do some good in coating over the ulcers in the intestine, and by tending to decrease excessive peristalsis. The subcarbonate of bismuth is better to use than the subnitrate, as there is less danger or poisoning by absorption.

INTESTINAL ANTISEPTICS: These drugs do little good in infectious diarrhœa, for the organisms that cause it are likely to be deep down in the ulcers under the mucous membrane, and you cannot reach them. Also, you cannot give large enough doses to a child to be really sure that you are doing much good.

OPIMUM: The indications for opium in infectious diarrhœa are the same as for the fermentative type.

STIMULANTS: Stimulants may be needed, if the child is much prostrated. Strychnine, camphor, caffein or alcohol may be used. Personally, I prefer caffein, given subcutaneously.

Chloral and Sodium Bromide: These drugs are indicated for restlessness. Children bear them well, and they may be given in good-sized doses.

Now for the gas bacillus type of diarrhœa: The treatment in this condition, that is, the food treatment, is different from the treatment of the dysentery type; the rest of the treatment is just the same. The gas bacillus is an organism that thrives on carbohydrate food, so it is absolutely wrong to feed a child with a condition due to the gas bacillus on carbohydrates. The gas bacillus cannot flourish if there is a good deal of lactic acid in the intestines, and these cases will sometimes do remarkably well on buttermilk or on lactic acid milk. I do not believe that the Bulgar tablets are usually of much good, because they are so likely to be inactive, and buttermilk or lactic acid milk which you have made with a liquid culture is much better.

The rest of the treatment for this type is just the same as for the other types. The feeding is the only point that is different. Get just as much buttermilk or lactic acid milk into the child as you can and keep the carbohydrates low.

I think most of the cases you have down here are of the dysentery type, so the treatment in most cases will be that for this type. You can test for gas bacillus very easily by putting a small portion of the stool into a test tube of milk, boiling it for three minutes, then stopping it up and incubating it for twenty-four hours. If the gas bacillus is present the casein will be coagulated, will be full of holes, and will smell like rancid butter, due to the formation of butyric acid from the fat and sugar in the milk, and a good many gas bubbles will be present.

Usually, if you start to feed a "gas" case on a high carbohydrate food, as you would do for a dysentery case, the temperature will go up, and the baby will be sicker, so if this happens it is fair to assume that the other type of treatment, that is with buttermilk, is indicated.

How are you going to tell infectious diarrhœa from the fermentative type? Usually in the fermentative form, the child is not so ill. In this type, too, there is usually no blood in the stools, and there is never any pus. In infectious diarrhœa there is nearly always

blood and pus in the stools. Another thing, the temperature in fermentative diarrhœa rarely continues elevated for more than a day or two, and it is usually not very high. In infectious diarrhœa it is likely to be high, and to continue elevated for a number of days.

Sometimes when called to a case it is impossible to tell at the first visit with which type of diarrhœa you are dealing. Under such conditions it is safe to clean the baby out and starve him for twenty-four hours, and by this time you can usually decide which type it is.

Another condition with which infectious diarrhœa is sometimes confused is intussusception. In this condition the abdomen is likely to be distended, in infectious diarrhœa it is usually sunken. You may feel a tumor in intussusception, and you do not in infectious diarrhœa. All the symptoms in intussusception are likely to be more severe, and vomiting is prominent. The stools in the two conditions may look almost exactly the same, but if there is much fecal material present with the blood and mucus, the case is more likely to be one of infectious diarrhœa.

The subject of these diarrhœas is an extremely difficult one to present in a clear and clean cut manner, for the reason that no two people will tell you the same things about them, and I know perfectly well that there is plenty of room for criticism and difference of opinion about the things I have been telling you to-day. I have not spoken of the old-fashioned "cholera infantum" that most of you older men have seen, as it is fortunately a very rare condition today, and we practically never see it in Boston. I have never seen a case myself, and so hardly feel qualified to talk about it.

There will be no more lectures on feeding and I want to give you a very brief summary of the central ideas of the subject—a birds'-eye view of the whole.

The subject of infant feeding is in chaos—what is believed in Boston is not believed in Chicago—what is believed in Berlin is not believed in New York, and so on; what is regarded as gospel in one city by one group of pediatricians may be looked upon as of very little consequence by an equally capable group of pediatricians in another city. It is obviously not just or reasonable to suppose that intelligent pediatricians in one

city do not know how to feed babies because they use methods which are different from those used by their confrères in another city—and still each group of men firmly believes that its own methods are the correct ones, which is only natural. I suppose that if the end results of the feeding work of men of equal experience, in the various cities, using different methods, were to be compared, these results would be found to be very similar.

I have endeavored to teach you Boston ideas of feeding entirely, and have paid no attention to the ideas of men who have different methods than ours: not because I believe that they are of no value—but because I believe our methods are the most reasonable and logical, and because it is best to save confusion by *learning* one method instead of *skimming* over several.

Let us consider what the basis of the Boston method is:

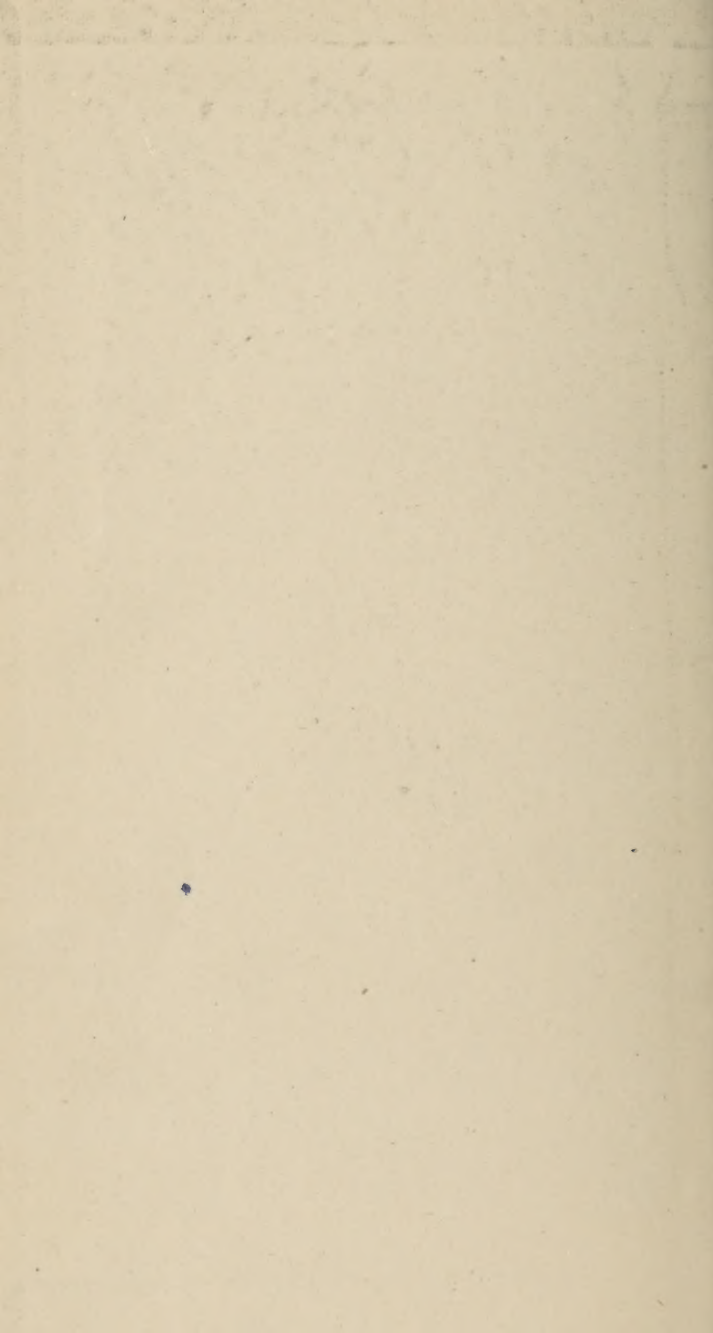
1. *A baby must have a well balanced food.*
2. *He must have enough of it in fuel value.*

These two propositions are self evident, and will be admitted by every one, no matter what methods of feeding he uses.

We believe, in Boston, that most of the digestive troubles of babies (exclusive, of course, of such conditions as infectious diarrhœa), are caused by an excess or a deficit of one or more of the food elements in the milk—fat, sugar, protein, or salts—or to a faulty digestion or absorption of one or more of these elements when they are perhaps in normal quantity in the milk. Therefore it is reasonable and essential to know approximately how much of each of these elements is in the milk that we feed to any baby. The most convenient and accurate way of expressing this quantity is by percents of the various elements. We take into consideration the elementary composition of the food, and also the fuel value of the food as a whole as expressed in calories, or heat units. We determine what food element or elements are causing the baby trouble, by a study of his diet, himself, and his stools, and regulate his subsequent food supply by an increase or diminution of an element or elements of the food, or of the total quantity of food, according to the indications thus determined. We lay especial stress on the

examination of the stools, macroscopic and microscopic, and believe that such examination helps a great deal in the proper regulation of the baby's diet, by giving us a guide as to what he is or is not digesting.

This is a brief exposition of the principles upon which "percentage feeding" is based: there is nothing complicated about it, rather it tends to make a difficult subject clearer—it is rational, practical and scientific at the same time—and its principles and practice can be grasped by anyone who will take the trouble to give it a little thought.



R. G. L.

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